MACHINERY

October, 1909

THE DESIGN AND MANUFACTURE OF A HIGH-GRADE MOTOR CAR*

RALPH E. FLANDERS†

FOUR years ago, at the New York Automobile Show, the writer's attention was first attracted to the Stevens-Duryea machine, particularly from the standpoint of design. It exhibited a thoroughness and consistency in the proportions and arrangement of its mechanism, which was at that time much rarer in automobile construction than now. The good impression then produced has been deepened by a recent visit to the factory, where the management very courteously granted the freedom of the shop, and answered without a quiver or qualm all the questions that a prying editor could think to ask. Some of the results of this visit are here set forth.

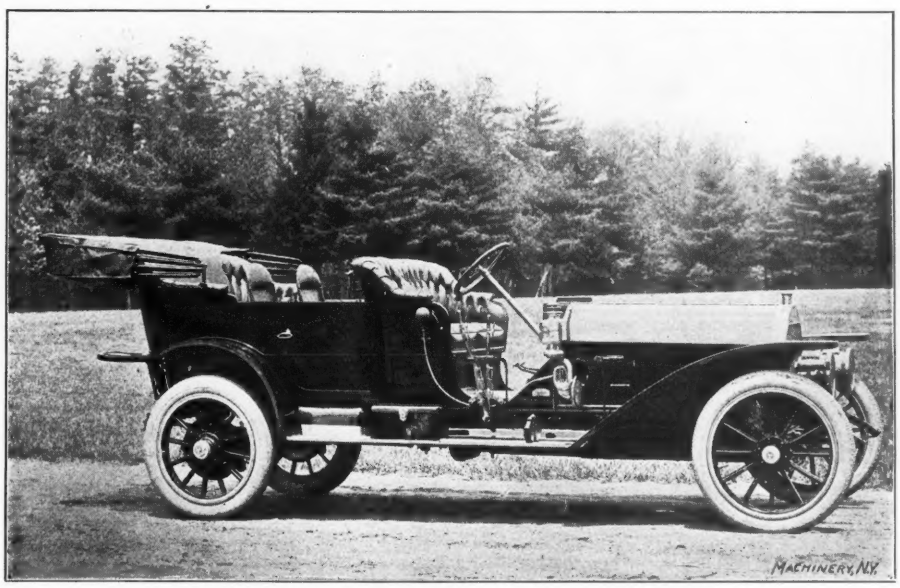


Fig. 1. Stevens-Duryea "Big Six" Motor Car, 1910 Model

The Factory and its Product

The shops of the Stevens-Duryea Co. are located at Chicopee Falls, near Springfield, Mass., in part occupying buildings originally used by the Spaulding bicycle factory. The business was founded by Mr. J. Frank Duryea and Mr. William H. Remington, who began experimenting with automobiles in 1892. Mr. Irving H. Page later became interested in the work, and his firm, the J. Stevens Arms and Tool Co., commenced making cars for the market in 1899. The business grew so rapidly that it was found wise in 1905 to organize a separate firm—the present Stevens-Duryea Co.

These shops are at present building a 40 H. P. six-cylinder machine, a "light six," 35 H. P., and a four-cylinder 24 H. P. car made in two lengths of base. Many of the engine and transmission parts of the 40 H. P. and the four-cylinder machines are identical, thus simplifying the manufacture to a marked extent.

Description of 40 H.P. Six-cylinder Machine

Without doubt there are many readers of MACHINERY who are quite familiar with the automobile as a machine. There are as many who are not, however, so if the knowing ones will skip the next four or five pages, they will come to an article relating to manufacturing methods, which will doubtless be of more value to them. The average reader, however, should be interested in an elementary description of this car, which, except for certain important details which will be mentioned, may be taken as typical of the design of high-grade cars in general.

In Fig. 1 is shown a side view of the "Model Y," 40 horse-power, six-cylinder machine, with 36-inch wheels and 142-inch wheel-base. An automobile may be divided into two parts—the body and the "chassis." The former is the product of the carriage-maker's art, the latter of the mechanic's and engineer's. The chassis of this machine is shown in Figs. 2 and 3, to which reference should now be made.

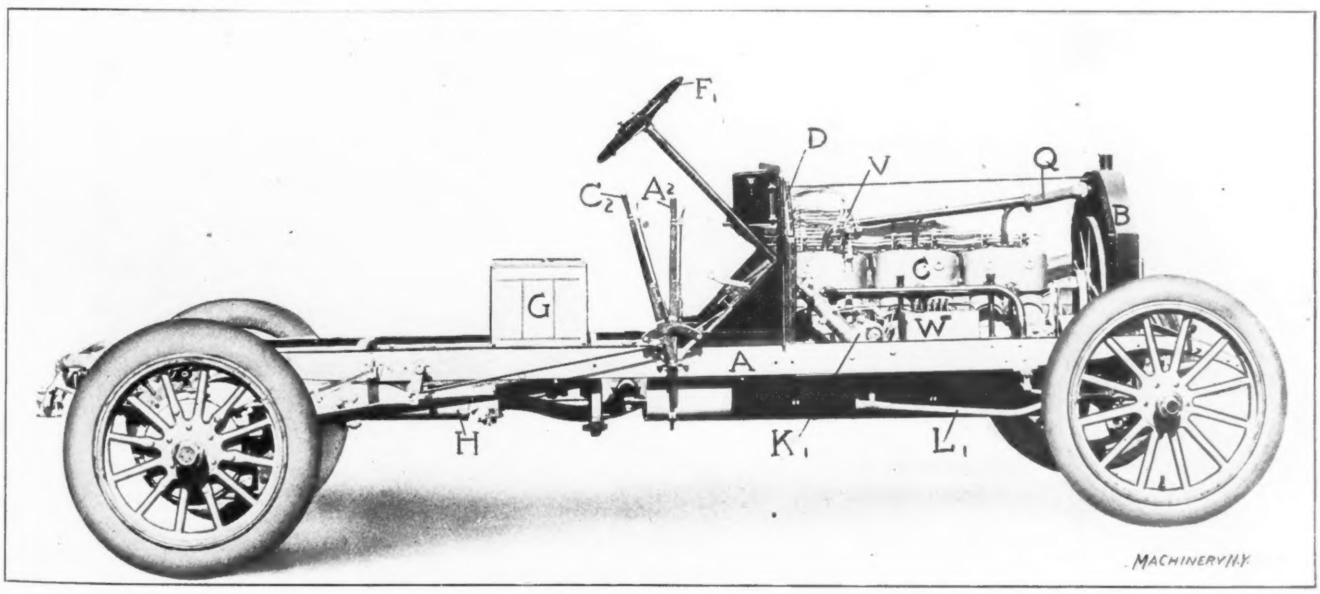


Fig. 2. Side View of Car with Body Removed, showing Chassis

The mechanism and body of the car are supported by a frame whose side members, of chrome-nickel steel, are shown at *A*. These are connected by four cross pieces, and are supported on the front and rear axles by the spring connections shown. The cross pieces are also pressed from chrome-nickel steel, and are hydraulically riveted to the side frames. A platform spring suspension is used at the rear, hung on connecting shackles designed to overcome the side roll met when round-

* For further information on this subject, see "Machines and Tools for Automobile Manufacture," June, 1909, and articles there referred to.
† Associate Editor of MACHINERY.

ing curves in large and fast cars. The springs are made from steel selected after careful tests of both American and imported materials. The cost of the brand selected was far in excess of the nearest competitor, but it gave an endurance under repeated shock and reversal of stress not met with in any other make.

On the chassis frame are mounted, first the radiator *B*, next the engine *C*, then the dash-board *D* with its steering and controlling mechanism, the clutch and speed change mechanisms at *E* and *F* respectively, the gasoline tank *G*, the muffler *H* for the exhaust, the propeller shaft *J* for transmitting the power to the rear axle, and the rear axle with its differential gearing at *K*.

The Unit Power Plant, with Three-point Support

The engine is shown more clearly in Figs. 4 and 5, which show the "unit power plant" form of construction, one of the important original features of the design. This peculiarity consists in mounting the engine, clutch, and transmission casings as a single rigid member, supported by a three-point bearing on the flexible frame. Supports *L* bear on the two side frames, while pivot *M* is riveted to one of the cross pieces. This allows the whole of the contained mechanism to run without distortion or bending, even on roads which rack the frame severely, and thus results in less friction and lighter structural parts, giving a high available horse-power per hundredweight of load. It also permits the power plant to be assembled as a whole and to be bolted in place without fitting. This construction, which is the distinctive point in the design of this motor, has been successfully followed by the builders for the last five years, and it is one of the things which serve to give an attractive mechanical appearance to the whole mechanism. Only one double set of universal joints is required, that connecting the propeller shaft with the transmission gearing at one end, and the differential gearing at the other.

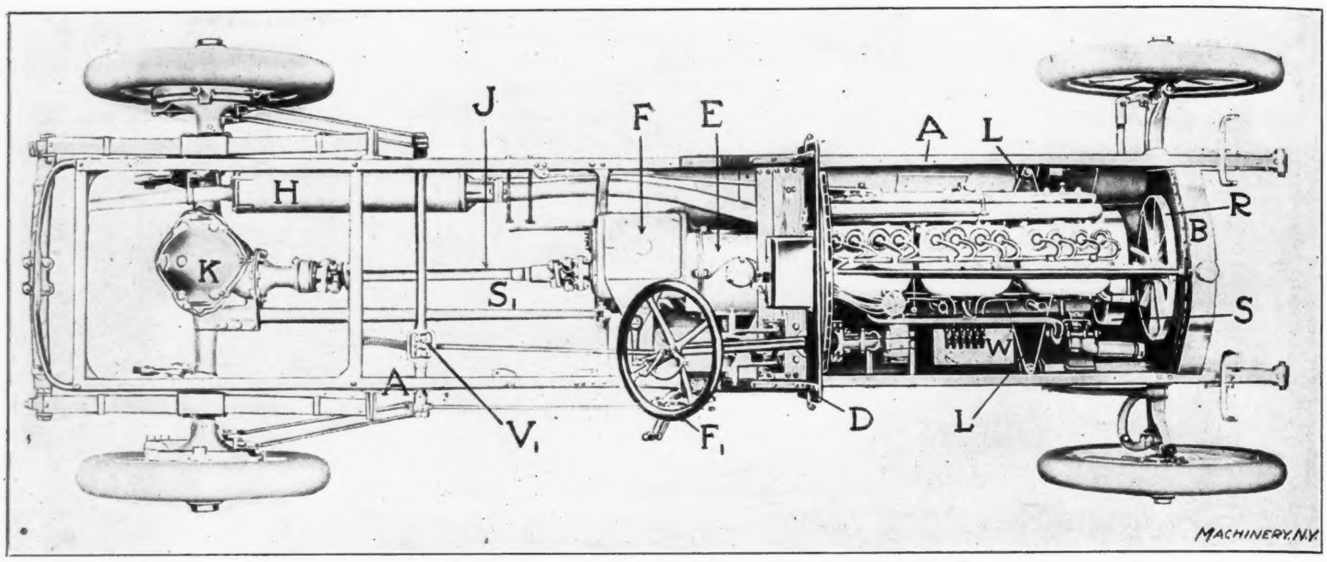


Fig. 3. Top View of Chassis, showing Arrangement of the Mechanism

The cylinders are grouped in three two-cylinder castings *C*, bolted to the crank case *N*. As is common with internal combustion engines in ordinary practice, they are water jacketed, there being a continuous circulation from radiator *B* through centrifugal pump *O* and pipe *P* to the water jackets, thence back again through the return pipe *Q* to the top of radiator *B*. Here the heated water is cooled by passing through sheet metal channels, having a large radiating surface exposed to the draft of wind produced by the passage of the machine through the air. This draft is increased by an aluminum fan *R*, belted to the pulley on the outside of fly-wheel *S*. An automatic tightening arrangement assures a serviceable drive throughout the life of the belt.

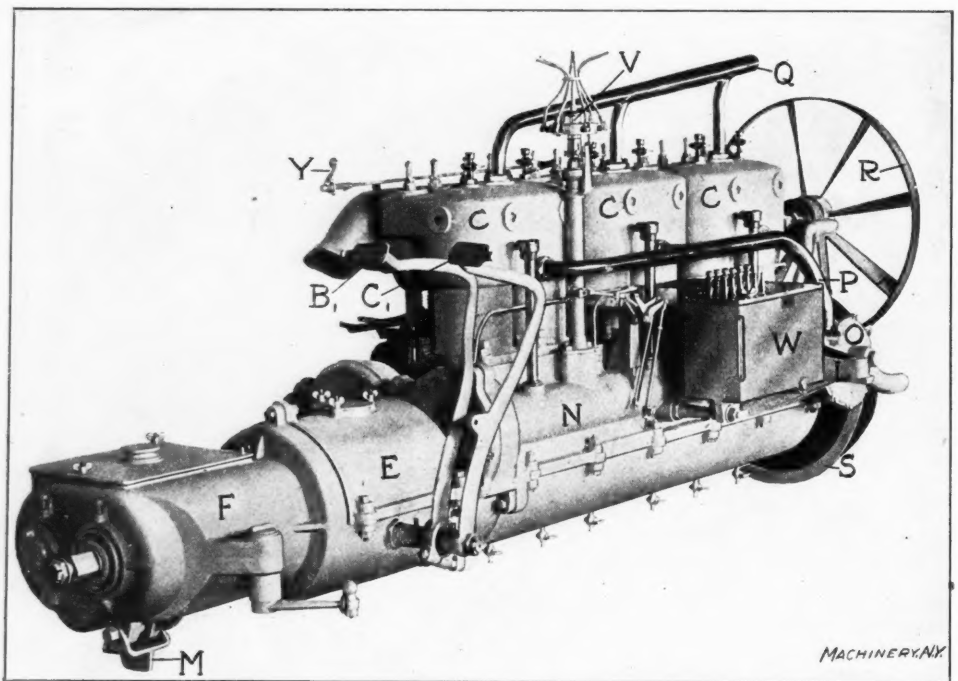


Fig. 4. The Unit Power Plant, comprising Engine, Transmission, etc.; View taken from the Timer and Lubricator Side

It should be mentioned that the placing of the fly-wheel at the forward end of the crank-shaft, as here shown, is unusual, the common construction being to locate it between the crank-shaft and the clutch. It tends, for instance, to bring more of the weight onto the front wheels, off from the heavily loaded rear wheels of the machine, and permits the reducing of the clearance over the roadbed in the center of the chassis, where there is the greatest danger of striking on high water bars, railroad crossings, etc. It will be readily seen that more clearance is required at the center of the machine than at the axles, when crossing a hump in the road.

Lubrication, Ignition, etc.

Two shafts mounted in the crank casing, on either side, above and parallel to the crank-shaft, are driven from it by enclosed gearing. The one at the side shown in Fig. 5 is the cam-shaft and is provided with twelve sets of cams for operating the six inlet and six exhaust valves, whose stems and

closing springs are plainly shown in the engraving. The driving gear of this cam-shaft is also connected with a pinion on the armature shaft of the magneto, whose function will be described later. The shaft on that side of the machine shown in Fig. 4, is known as the lay-shaft. Its office is the driving of the timer *V* which controls the ignition, the driving of the forced lubrication mechanism at *W*, and of the water jacket circulation pump *O*.

gasoline, and a supply of fresh air to furnish the oxygen for the charge. The gasoline is received in a float chamber, where the level of the liquid is maintained by a suitable float and valve. An automatic valve provides for a constant proportion of oxygen and fuel at widely-varying speeds. The carburetor is provided with a throttle which controls the needle valve connection in the feed pipe, together with the butterfly valve in the suction to the cylinders, thus providing

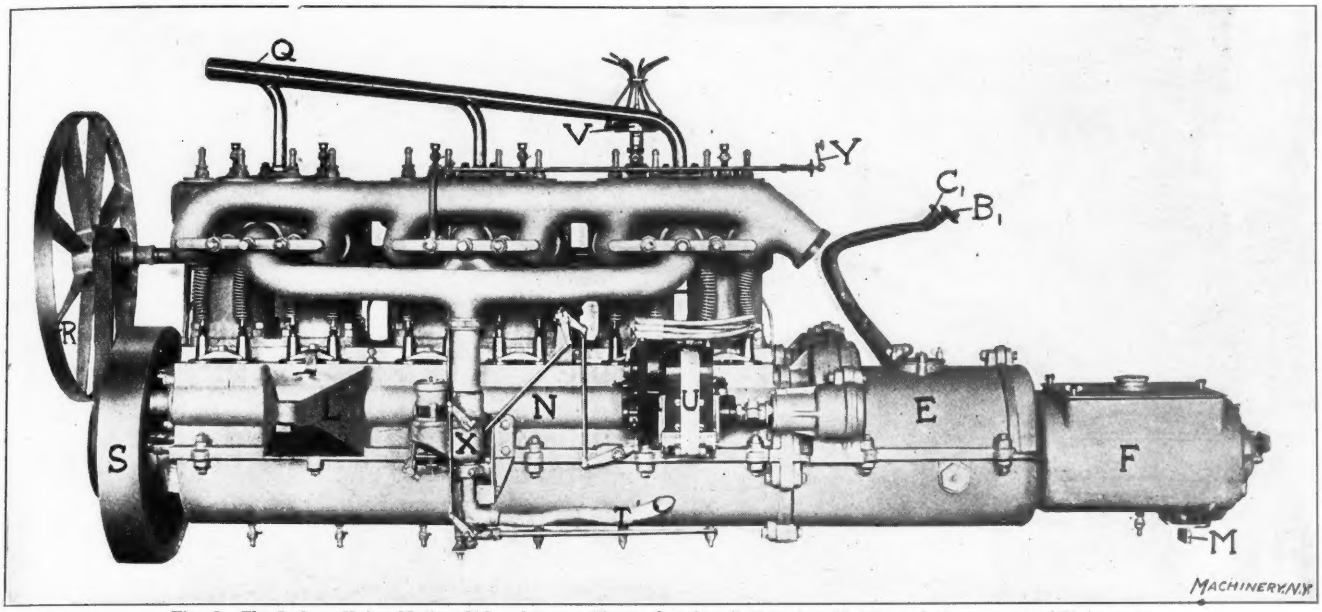


Fig. 5. The Left or Valve Motion Side of Power Plant, showing Carburetor, Magneto, Arrangement of Piping, etc.

the driver with means for varying the amount of charge furnished the machine; this controls the speed without shifting the gears in the transmission case. The automatic air valve is controlled from the seat by a handle *Y* on the dashboard, which permits the obtaining of a proper mixture for the starting. A button at the front of the radiator, where the machine is cranked for starting, also provides means for flooding the carburetor with fuel for a send-off. The throttle is controlled from a lever on the steering wheel concentric with the spark control lever or from an "accelerator pedal" on the foot-board.

The lubricator gives a forced oil supply with sight feed, and is always in operation when the engine is in motion. The six-throw crank-shaft is mounted in four bearings in the crank case, with two cranks between each pair of bearings. The boxes at these points are connected with the lubricator *W*. The lower half of the crank case forms a reservoir for

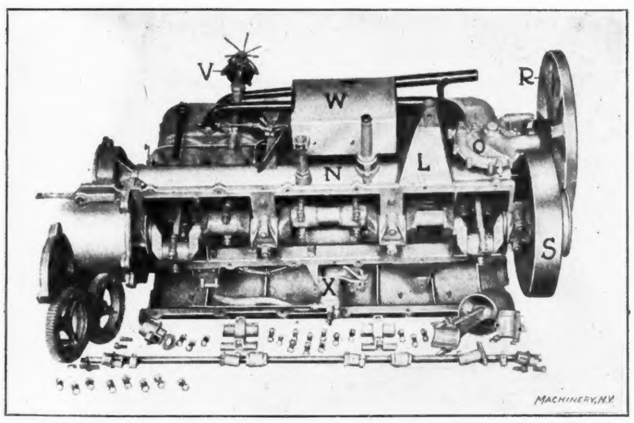


Fig. 6. View of Engine from Beneath, showing Removal of Piston, Cam, and Lay-shafts, etc., without Dismantling

the oil escaping from the main bearings. The connecting rod splashes into this and thus supplies the pistons, connecting-rod bearings, etc., with the necessary lubrication.

The ignition in each cylinder is effected by either of two systems, the one by storage or dry battery and induction coil, and the other by means of a magneto *U* connected by gearing with the crank-shaft. The battery and spark coil is used in starting, while the magneto is used for regular running. The spark coils and switches are located on the dashboard. A lever on the steering wheel, as will be described, is connected with the commutator or timer *V*, which distributes the current to the six cylinders, in such a way as to enable the operator to advance or retard the spark at will.

The Carburetor and Fuel Supply

An important and rather delicate piece of apparatus essential to the operation of the gasoline engine, is the carburetor, shown at *X* in Fig. 5. This receives a supply of gasoline through a feed pipe from the tank *G* (see Fig. 2), a supply of air through *T* heated by the exhaust gas for vaporizing the

The gasoline supply tank *G* is located under the front seat. It contains a partition near the bottom which saves about three gallons out of its twenty gallons' capacity, for use in emergency. By the manipulation of cut-off valves passing

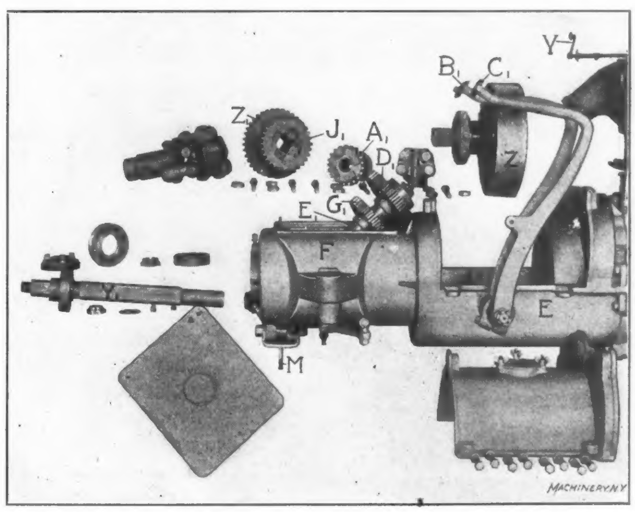


Fig. 7. Clutch and Transmission Gear Members Dismantled to show Construction

through the left side frame of the chassis, it is possible to use this reserve supply after the tank has been otherwise exhausted. This provision is a great comfort to the motorist at critical times.

The Clutch and the Transmission Gearing

In casing *E* is mounted the clutch *Z* (Fig. 7) connecting the engine with the transmission to the driving wheels. This is of the multiple disk type, with alternate disks keyed to the

driving and driven members. The driving disks have a wired asbestos facing which makes a superior friction surface, and gives a high resistance to heat as well. This construction obviates, and in fact makes impossible, the use of oil in the clutch. The friction surfaces are held in engagement by a spring, and are released by a pedal B_1, which projects through the foot board at the driver's side of the machine. The spring is so proportioned as to give a smooth, easy engagement, entirely out of the control of the driver, who thus finds it impossible to start the machine with a sudden shock. The second foot lever, C_1, is connected with the rear wheel brakes, as will be described. The driven member

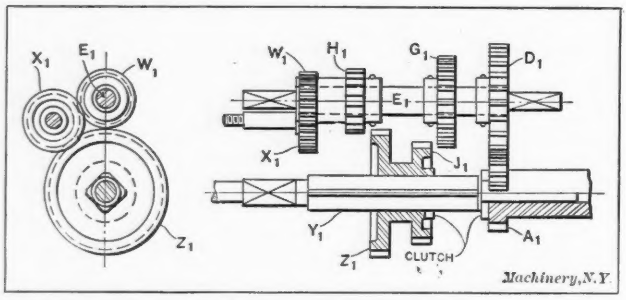


Fig. 8. Sketch showing Arrangement of Gears in Transmission Case

of the clutch is connected with the driving shaft in the transmission case or speed box F. Contained within it is a mechanism which, by the aid of the sliding gears, clutches, etc., permits of the obtaining of three forward and one reverse speed.

The operation of this gearing will be understood from the sketch shown in Fig. 8. Gear A_1 receives its movement from the clutch. It meshes with gear D_1 keyed to the secondary shaft E_1, which is thus in motion whenever the engine is running and the clutch is engaged. This shaft carries also gears G_1, H_1, and W_1, the latter of which drives, in turn, the idler X_1. Squared shaft Y_1 is directly connected by means of propeller shaft J (Fig. 3) and the universal joints with the rear axle. On Y_1 is mounted the double sliding gear Z_1. Clutch teeth are provided in the faces of the gears A_1 and J_1.

In the position shown in Fig. 8, the transmission is in the neutral position, so that the motion from the clutch is not transmitted to the axle. The right-hand end of shaft Y_1 lies loosely in the revolving gear A_1. When the sliding gear is thrown to the extreme right, the clutch faces of A_1 and J_1 are engaged, so that shaft Y_1 is driven directly, and at the highest speed, from the clutch. By shifting it a step to the left, J_1 is thrown into mesh with G_1, thus giving a lower rate of speed through the back gear shaft E_1. A still further movement to the left, past the neutral point shown in the engraving, brings Z_1 into engagement with H_1, giving the lowest forward speed. A final movement to the left engages Z_1 with idler X_1, thus reversing the drive.

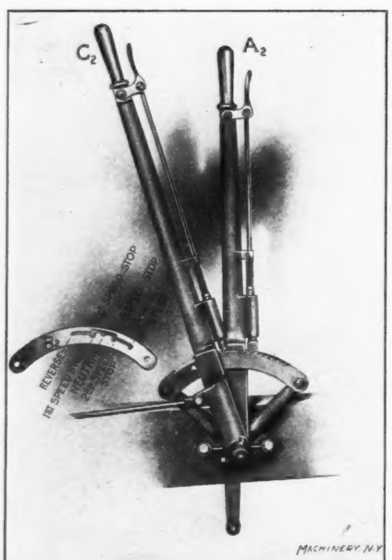


Fig. 9. The Speed Gear Control and Emergency Brake Levers

The shifting of gears Z_1 and J_1 is effected by a forked lever connected with lever A_2 (Fig. 9) at the side of the machine, which thus controls the speed changes. This lever is provided with a latch connected with a pin in the slot of the quadrant B_2, operating in a manner easily understood from the engraving. It will be seen that it is possible to move between the reverse and the lowest speed, or between the second and the high-speed, without touching the latch, and it is possible to make all the movements rapidly and precisely by the sense of touch without looking at the quadrant at all.

The Differential Drive

Propeller shaft J leads from the transmission case F to differential case K on the rear axle. The bevel gear M_1 (Fig. 11) is connected with the two rear wheels by a differential mechanism, whose function it is to give an equal tractive force to each of the two wheels, but at the same time to permit either of them to run ahead or lag behind the other as may be required in rounding curves, riding over obstructions, etc. The principle of this mechanical movement will be understood by referring to Fig. 10.

Referring first to the sketch at the left, N_1 is the pinion on the propeller shaft and M_1 is the driven bevel gear, concentric with the axle. This gear and shell O_2 to which it is bolted, revolve freely on the hubs of E_2 and F_2. Within the shell are mounted radial pivots on which revolve, loosely, bevel pinions D_2. These engage with bevel gears E_2 and F_2, connected respectively with the right- and left-hand axle shafts T_1. It will be seen that under ordinary conditions the rotating of gear M_1 carries gears E_2 and F_2 along with it, by the pull exerted on them by the bevel pinions D_2, which are stationary; thus the two rear wheels are driven at the same rate of speed. Suppose now that the right-hand wheel be held from turning, so that gear E_2 is stationary, then the rotating of bevel gear M_1 will roll pinion D_2 about on E_2 with

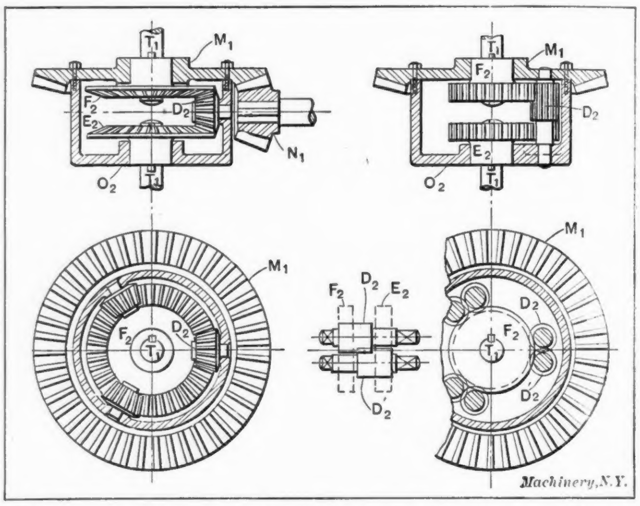


Fig. 10. Sketch showing Principle of the Bevel and Spur Gear Types of Differential Gearing

a compound action, which will give F_2 twice the rate of speed it had before. In the same way, F_2 can be held from revolving, in which case E_2 will have twice its normal speed, or either of them may be slowed down, in which case the other is speeded up correspondingly. The driving force on both wheels, however, is always the same.

An alternative form of this device is shown at the right of Fig. 10, in which each of the bevel gears D_2 is replaced by a pair of spur pinions D_2 and D'_2, meshing with each other and with spur gears E_2 and F_2 as shown. A little study will show that the action of this device is identical with that shown in the sketch at the left of the figure, the only change being the employment of spur gearing in place of bevel gearing. The differential used on the Stevens-Duryea machine is of the second or spur gearing type.

The Full Floating Type Rear Axle

The differential gearing is contained in the casing O_2, which forms the central member of the axle. Tubular extensions to either side carry the spring supports P_1 on which the weight of the car rests. The brake flanges Q_1 and the wheel bearings at R_1, all of which are solid with each other, are nonrotating. The rear axle, however, is permitted to rock in spring supports P_1. The torque rod or tube S_1, which is fast in case O_1, extends toward the center of the chassis, where it is hung in a spring suspension as seen in Fig. 3, permitting a limited vibration up or down, with a constant force urging it toward a central position. This construction furnishes the resistance against the climbing of pinion N_1 on bevel gear M_1. In case of sudden starting or stopping, a limited amount

of climbing either way is permitted, the torque rod being raised or lowered against the spring pressure to correspond. This greatly decreases the danger of gear breakage.

The construction thus described belongs to what is known as the full floating type axle. The wheels are mounted on ball bearings on stationary journals R_1. Shafts T_1 are provided with squared driving ends engaging sockets in the differential gearing in casing O_1 at one end, and similar sockets cut in driving dogs U_1 at the other end. These latter members have driving slots engaging dove-tails in the hubs of the wheels, to which the power is thus transmitted. The

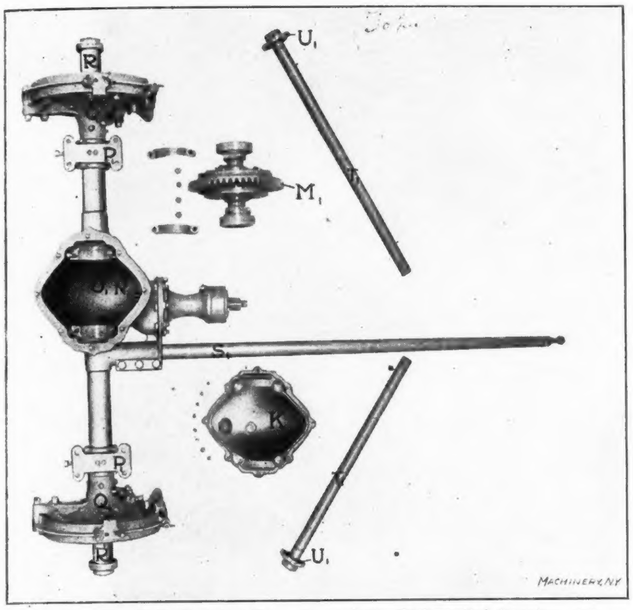


Fig. 11. The Full Floating Type Rear Axle, Differential Gearing, etc.

squared ends of shafts T_1 are rounded to permit a slight rocking movement in their sockets in the differential gearing and driving dogs U_1. This permits the springing of the rear axle under the load without cramping the driving mechanism.

To allow for the springing of this axle under the load, the two sections of tubing on either side, between members O_1 and Q_1, are held in bored seats which point downward at an angle of ½ degree from the horizontal on each side. Thus the rear axle wheels point in toward each other at the bottom on an angle of ½ degree from the vertical, giving a much better appearance than would be the case if they should by some mischance point the other way. It would take a load in excess of any which would ever be applied to spring the axle and bring the wheels into the vertical plane. It is stated that when the wheels are exactly vertical, they have the appearance of being sprung out at the bottom, into the position occasionally seen in a vehicle of the "one-horse-shay" type.

The Brakes

The brake mechanism of the automobile is of the utmost importance, as is realized by anyone who has had anything to do with these machines whether as driver, passenger or pedestrian. It is usual to provide two complete sets of braking mechanism, one for regular use and the other for emergency. That for regular use is controlled by the foot lever C_1 (see Fig. 4) which is connected with a reach rod leading to double cranks on a transverse rock-shaft at V_1 (Fig. 3). One section of this rock-shaft is connected with the brake at the right side of the machine, and the other at the left. An equalizing lever between the two insures an even pressure on each of these two brakes, even though one be much more worn than the other. The brake is of the band type, applied to the outside of a brake rim fast to the hub of the wheel. The emergency brake is operated by lever C_2 (Fig. 2). This, by means of a second rock-shaft concentric with V_1, controls internal expanding ring brakes in the hubs of the wheels.

The Control of the Machine

The steering gear will be best understood from Figs. 2, 3 and 12. The wheel F_1 is mounted on a tubular shaft which carries at its lower end a worm engaging the segment of a worm-wheel G_2 in casing K_1. To the hub of this segment is connected a bell crank H_2 which, through the operation of the steering rod L_1 (see Fig. 2) and suitable connecting cranks and links, turns the front wheels to the right or left as may be required. Spring cushions are provided at the ends of steering rod L_1 so that sudden shocks and twists of the wheels are not transmitted to the worm-gearing and the steering wheel, even when traveling at a high rate of speed. As most of our readers doubtless know, the center line of the pivots about which the wheels are swiveled meets the road at about the point where the tire touches it. This makes it possible to turn the wheels easily when standing still, and decreases the danger of accident while running, as well.

As previously stated, the throttle control and the timing of the spark are effected from levers placed at the hub of the steering wheel. Lever K_2 controls the throttle. This is mounted on a tube passing through the steering wheel tube and connected at its lower end by bevel gear segments with a bell crank L_2, which is, in turn, connected by suitable rods and levers with the carburetor. Inside of the throttle lever tube is still another fixed tube on which is mounted the segment M_2, which is thus held stationary. This is provided with notches for locating lever K_2, and lever J_2 as well, which latter controls the timing of the spark. This is mounted on a rod which passes through the center of the system of tubes and is connected by bevel segments with lever N_2 leading to the commutator or timer V.

It may be well to recapitulate as to the functions of the levers, etc., used in the control of the machine. At the front of the radiator is the crank by which the motor is turned, for starting. By the side of it is a button connected with the carburetor, for flooding the latter at starting to obtain a rich mixture on the first stroke. On the dashboard is mounted a lever Y, for setting the automatic air valve to supply the proper amount of oxygen for starting. Beside it is a switch for throwing the ignition spark from the battery to the magneto when the machine is changed from the starting to

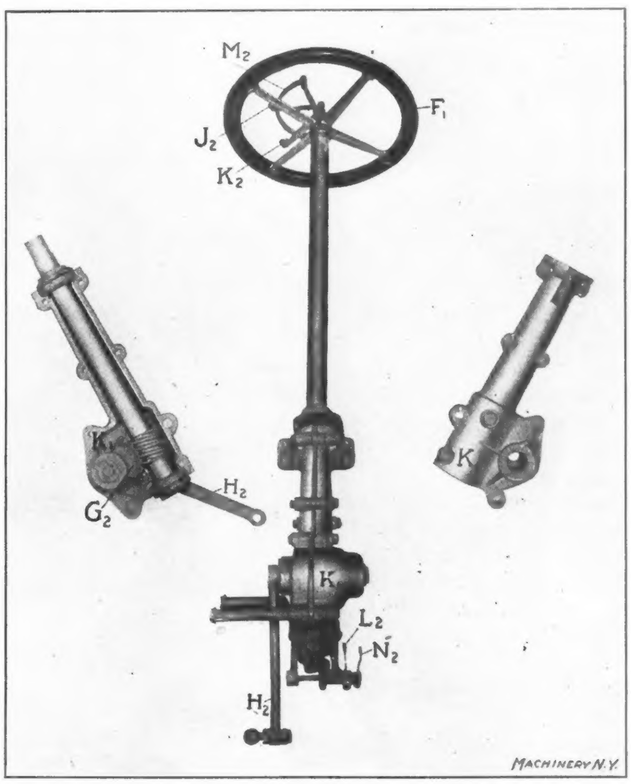


Fig. 12. The Steering Post, with its Throttle and Sparking Connections

the running condition, and *vice versa*. On the dashboard are also mounted the spark coils. Through the foot board project the two pedals B_1 and C_1 controlling the clutch and the operating brake respectively, as described. Hand levers C_2 and A_2 control the emergency brake and the speed changes respectively.

Two small pedals are also provided on the foot board. One of these is connected with the throttle in such a way that this may be controlled by the foot instead of by the hand if required. It is called the accelerator. By its use, when the hand throttle lever has been set to a certain point, the valve may be opened clear out to the maximum, as desired, by the

foot, thus giving immediate control under varying conditions of traffic. The other pedal operates a valve which cuts out the muffler. This is occasionally done to make the exhaust audible, for finding out how the engines are working, and also for removing the back pressure, and thus giving every ounce of power possible on critical occasions. At times, too, it would seem to the disinterested bystander that the muffler is cut out from "cussedness" pure and simple.

These levers, pedals, etc., with the main and supplementary gasoline supply valves previously mentioned, give the driver complete control of a powerful, swift machine, if he has the knowledge, experience and nerve to use them properly.

General Considerations in Automobile Design

A glance at the illustrations will serve to show that the chassis of the modern high-power automobile is a rather complicated, highly-specialized, and carefully-designed piece of mechanism. It is within the memory of the child in kindergarten when this was not the case, and the writer has painful memories of his duties as consulting physician to one of the best of the machines in existence six years ago. At that time, the mechanism of the automobile did not have the homogeneous, appropriate structure that the successful machines of the present day possess. It had a gasoline engine, an epicyclic speed change mechanism, a jack-in-the-box differential gear, and chains leading to the rear wheels of a "horseless carriage." Over the mechanism thus described wandered a maze of levers, braces, pipes, wires, etc., supported at intervals at any part of the mechanism which happened to be in convenient reach. That, however, was before the automobile "found itself." The present development has been the result of the experience of many men with break-downs and failures, as well as of an enormous amount of theoretical work in the matter of testing of materials and analysis of conditions. These theoretical and practical results have been combined on the drawing board and the resulting machine has the appearance of having been *designed* rather than simply *built.*

The guiding principles in the design of the automobile relate to strength, power, lightness, durability, accessibility, and economy in operation. The matter of economy in construction and materials is about the last thing to be thought of, instead of the first, as with many other classes of machinery. The severe and often reckless usage received by one of these machines demands special treatment in the design and construction which should not ordinarily be necessary.

As an illustration of what has been said in this respect, attention may be called to the method of connecting the driving members of this machine from the engine through to the wheels. In no place throughout the length of the chassis are keys used for this work. Reliance is everywhere placed on square joints or dovetailed flanges. The crank-shaft is connected with the driving member of the clutch by a square taper socket. The driving member of the clutch is connected by a square socket with the driving shaft of the transmission gearing. The sliding gears of this mechanism are mounted on squared shafts, and the same squared drive is used for the universal joints, propeller shafts, pinion shafts, etc., through the intermediate pinions in the differential gearing at M_1 in Fig. 11, and through driving shafts T_1, to the driving dogs on the wheel hubs. These latter, as well as the side plates of the differential gearing, drive or are driven by the engagement of dovetailed teeth. The possibility of the shearing of keys, always present in machine parts subject to shock, is thus avoided. The makers believe themselves to be the only firm employing a complete drive of this kind.

In the matter of accessibility, a study of Figs. 6 and 7 will be found interesting. By removing the lower crank chamber casing and turning the crank-shaft to the proper position, the piston and piston rod may be removed without further trouble, and without removing cylinders or cylinder heads. The same is true of the cam- and lay-shafts. The covers provided for the clutch and transmission casings give evidence of care in providing easy means for inspection and removal of all parts likely to need attention. With a well-designed machine the man on his back under the motor car is a mere figment of the imagination.

Take it all in all, the present-day automobile is a machine of which the mechanic and engineer may well be proud.

MANUFACTURING METHODS IN THE STEVENS-DURYEA AUTOMOBILE WORKS

The subserviency of manufacturing considerations to considerations of strength, durability, accessibility, etc., mentioned in the preceding article, results in the design of parts which require special and interesting provisions for their economical production. Only a few of the operations particularly noticed in the Stevens-Duryea factory will be described here. They will serve, however, to give an idea of the general practice in such work, and will illustrate the ingenuity required for the solution of some of the problems.

Operations in the Machining of Cylinders

In Fig. 1 is shown a Beaman & Smith combined horizontal and vertical milling machine engaged in surfacing the base,

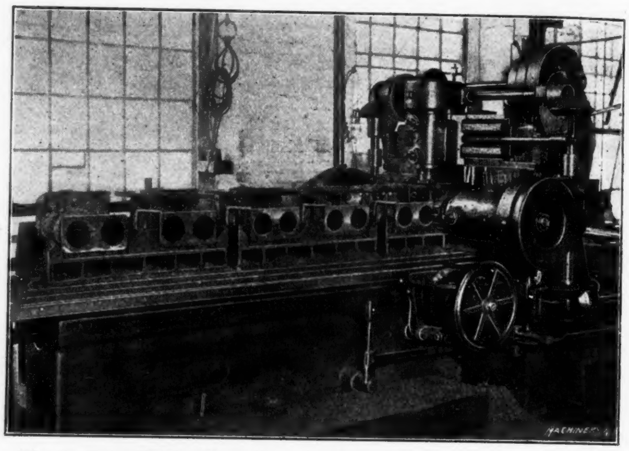


Fig. 1. Gang Milling Operation. Surfacing Cylinder Sides and Ends

exhaust and inlet flanges, and the spark plug bosses of a series of cylinder castings. The work is mounted in gangs according to the most approved methods. The picture is chiefly interesting in that it shows that the builders take advantage of wholesale manufacturing methods even in the building of a $4,000 machine. Of course, an extensive use of jigs and fixtures, besides reducing the cost of manufacture, results in a greater uniformity in the product and thus gives the advantage of an easy renewal of worn or damaged parts.

Fig. 2 shows a Beaman & Smith boring machine of a type we have illustrated and described in these columns. Fixtures mounted on the rotating table give provision for holding four double-cylinder castings. This table can be rotated and ad-

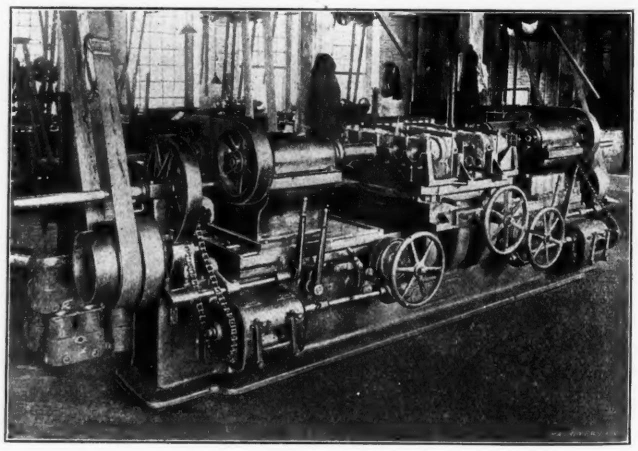


Fig. 2. Four-cylinder Boring Machine with Revolving Table

justed across the bed of the machine. On each side of the table, double boring heads may be fed in along the bed, one carrying roughing and the other finishing cutters, the feeds and speeds of the two heads being independent. A set of two castings being in place on the roughing end, the head is fed into them and one hole in each casting is roughed out. The work-table is then shifted, by means of the hand-wheel, against suitable stops and the other bore of each cylinder is roughed. The table is then indexed to bring these castings to the finishing side, where the same operation is repeated, the boring being here carried to size for grinding. This rotating of the table, in turn, brings a new set of the cylinders up to be rough-

bored. The process is continuous, the work being removed from the finishing side and new cylinders clamped in, while the rough boring is being completed.

For setting out the cutters in the boring bars, a construction is used which is similar to Fig. 16 of the Data Sheet of the May, 1909, issue of MACHINERY, except that a taper screw is used for forcing the blades out simultaneously. This is shown in Fig. 3 at the left. The cutters *B* bottom on this taper-headed screw *C*; filister head screws *D* serve to keep the blades forced down to their bearing on *C*, and so draw them firmly against the side of the slot. By this means two or more blades may be set out simultaneously for regrinding to exact size. A similar arrangement (see view at the right of Fig. 3) is used for cutters in the middle of long boring bars, except that the taper point of a screw tapped into the bar from the side, is used in place of the corresponding taper-headed screw in the first case.

The bore of these cylinders is finished in Heald internal grinding machines especially built for this work. These are

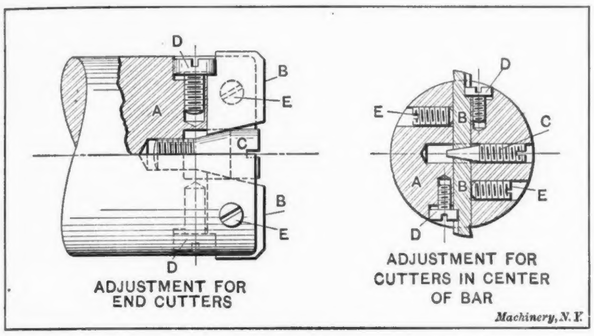


Fig. 3. Adjustment used for Boring-bar Blades

of the type in which the work remains stationary while the axis of the spindle is revolved about the center line of the bore and parallel with it, on such a diameter as to bring the outer periphery of the wheel in contact with the inner surface of the bore. The grinding spindle is fed out so as to rotate in a larger circle as the diameter of the bore is increased. An interesting feature shown in Fig. 4 is the provision of a flexible suction tube for drawing out the dust of the grinding through the inlet and exhaust ports, and also the provision made for water cooling. The water is not applied directly to the wheel, as in an ordinary external grinder, but is forced

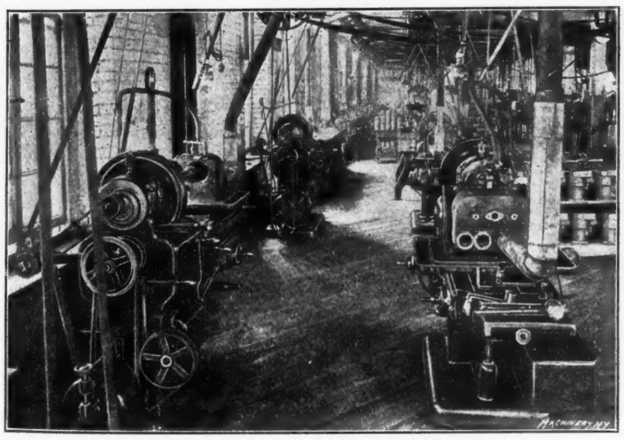


Fig. 4. Grinding the Cylinders. Note Connections for Exhausting the Dust and the Use of the Water Jacket for Cooling

instead through the regular water jacket of the cylinder casting. This reproduces, in a measure, the conditions met with in actual use, and so tends toward accurate work.

Machines and Fixtures for Grinding and Lapping

There are other operations of interest in the grinding department besides that of finishing the bore of the cylinders. Extensive use is made of the Pratt & Whitney face grinding machine for finishing flat surfaces; in fact, it has largely displaced the vertical milling machine for this work, on parts in which the surface to be finished is clear of projections or obstructions to the sweep of the wheel. The faces of the various casings, covers, inlet and exhaust pipes, etc., are finished on this machine. At the time of the writer's visit, most of these parts were still being made from castings on which 3/16 inch of stock had been left, in accordance with the usual practice of milling. The castings come true enough to shape, however, to permit this finish being reduced to 1/16 of an inch, or thereabout, thus materially reducing the time required.

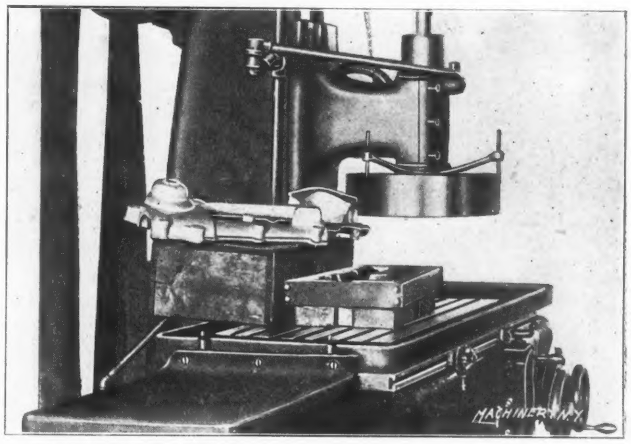


Fig. 5. The Acme of Simplicity in Fixture Making. Face Grinding the Steering Gear Casing

Even when removing 3/16 inch of stock the grinding machine has proved its superiority to the milling machine in the matters of cost, finish and accuracy. The foreman of the grinding department discovered that a little experimenting and investigating along the line of the grading of wheels made a tremendous difference in their durability and effectiveness in removing metal. For aluminum work a Vitrified

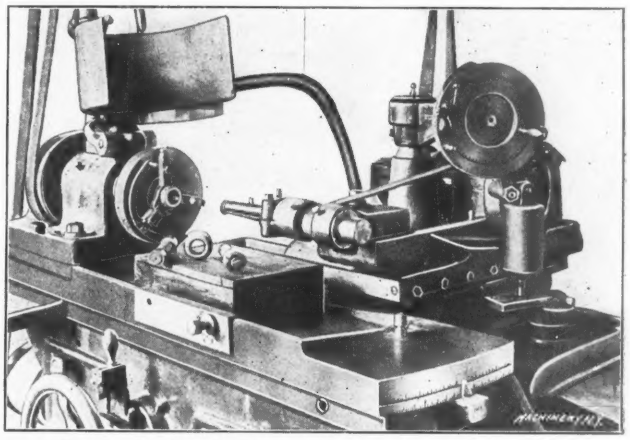


Fig. 6. Grinding the Bore of the Cams Concentric with the Cylindrical Surface

carborundum wheel of about No. 24 grain and grade H hardness is used, a soda compound being employed for cooling.

The cover side of the steering gear casing is one of the parts surfaced on the face grinder. A ridiculously simple fixture is used for holding it. This fixture, as may be seen in Fig. 5, is nothing more or less than a mass of lead melted and poured around a sample casting as a form. The work is set into the bed, thus prepared to receive it, and is supported on the table by its own weight, no fastening being necessary. The castings come uniformly enough so that they fit well in this device, except at certain points around the gates and sprues, where it is found necessary to relieve the form slightly to allow for these variations. It may be mentioned that the other or main member of the steering gear casing has a boss projecting above the finished surface of the joint, making it necessary to mill that surface. The joint is thus formed of one ground and one milled surface.

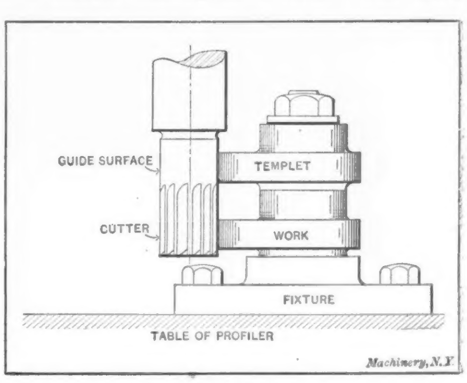


Fig. 7. The Simplest and Stiffest Arrangement for Cam Cutting

In Fig. 6 is shown the operation of grinding the holes in the cams. It is quite important that the cylindrical portion of the cam shall be exactly concentric with the cam-shaft to prevent shock or jar during the period when the valves are supposed to be closed. To make sure that this surface is concentric, the cam is located by it in the grinding fixture as shown. After the fixture has been mounted on the faceplate of the machine, the gripping surfaces of the two jaws at the right are ground out by the internal grinding attachment, to the radius of the cylindrical dwell of the cam. The cam is clamped against the surface thus prepared, by the lever, which forces a wedge across and down upon the cam, holding it firmly into the corner in both directions.

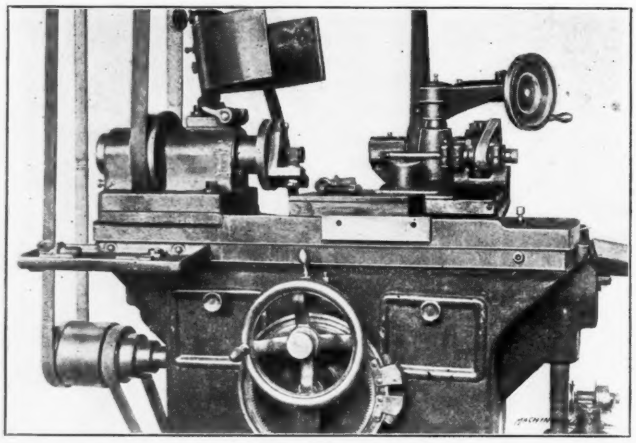


Fig. 8. Grinding the Holes in the Universal Joint Pivots

It will be seen that this car does not employ the integral cam-shaft. By giving careful attention to the locating of the cams on the shaft and by being careful to obtain a strong drive fit between them, the difficulties of loosening and dislocation, which the integral construction is expected to cure, have been avoided. It is thus permitted to cut the cams in a way which gives the best chance for producing accurate shapes and smooth finish. The obvious scheme shown in the sketch, Fig. 7, is followed, the operation being performed on a profile machine. The connection between the forming cam and the work is so close that the difficulties of springing and chattering, met with in the construction of the more elaborate machines required for integral cam-shaft, are avoided.

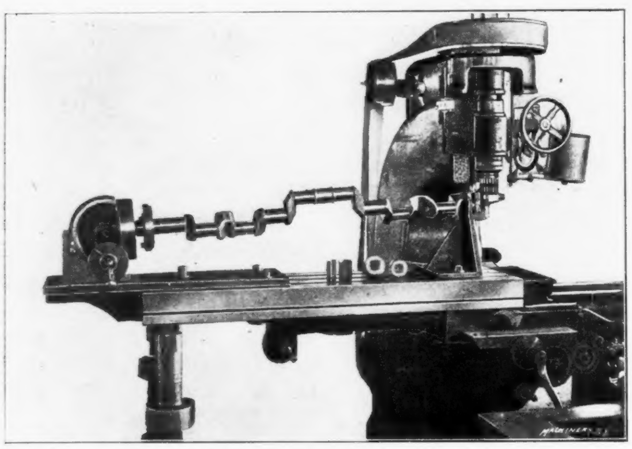


Fig. 9. A Vertical Milling Machine set up for Milling the Tapered Square Drive on the Crank-shaft

Another faceplate fixture for internal grinding is shown in Fig. 8, where it is employed for grinding the hole in the hardened nickel steel sockets used for the universal joints (see Fig. 7, previous article). The socket is held in the same way as when in use, by a nut screwed onto its threaded shank. It is also located in the same way, a pin in the fixture engaging a slot in the flange as shown. A limit of 0.0005 inch only is permitted in this operation, and an allowance of about 0.003 inch for the depth of the hole is the maximum, just enough being permitted for proper lubrication by the grease supply provided. This fixture is kept in place on the machine practically throughout the season. If at any time it is necessary to remove it, however, it can again be trued up by clamping a model socket in place, inserting a plug in the ground hole, and truing up the plug. These studs are held in the same way in the screw machine for roughing out the hole preparatory to grinding. The form of internal grinding spindle used should be noted. One of them is shown detached in Fig. 6, lying on the table of the machine. These spindles and their bearings are self-contained, interchangeable and adapted to work in holes of various sizes. The clutch drive provided rotates the spindle without side pressure on the bearings.

Machining the Members of the Squared Drive

As previously mentioned, the use of keys is tabooed in the drive of the Stevens-Duryea machine, their place being taken by square sockets throughout. A tapered square drive is used to connect the crank-shaft with the driving member of the clutch. The method of machining this is shown in Fig. 9. It has been found advisable to keep the milling machine set up for this work, continuously, owing to the difficulty of making a good taper square fit. When the machine has once been set it is kept so throughout the season. An ordinary dividing head is used, as shown, tipped up to the angle of the taper. To the face-plate of this dividing head is clamped the fly-wheel flange of the crank-shaft. The outer end of the crank-shaft is supported in a suitable steady-rest as shown. For shorter lengths of crank, filling pieces are employed, having flanges bolted to the face-plate at one end, and to the work at the other. The use of filling pieces permits machining of the full line of crank-shafts without disturbing the adjustments.

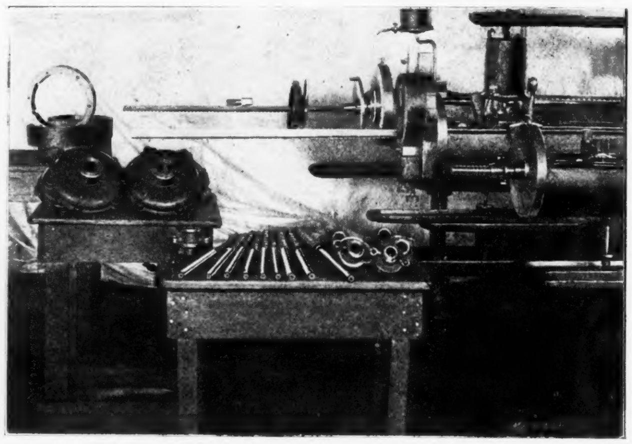


Fig. 10. A Set of Interesting Broaching Operations

The automatic cross-feed is employed in feeding the work past the end mill in the vertical milling attachment. The table has to be so far overhung that an out-board support is provided as shown, which permits this cross-feed. This consists of a sliding guide, supported by two standards, reaching to the floor and provided with jack screw adjustments for careful leveling.

The squared holes of the drive are finished on a La Pointe broaching machine in the usual manner. The further machine shown in Fig. 10 is engaged in finishing taper square holes in the clutch driving flange, this being the member into which the taper squared end of the crank-shaft shown in Fig. 9 fits. The hole is first reamed out to a taper a little larger than the distance across the flat of the finished hole. The work is then mounted on a broaching machine on the fixture shown in place. As may be seen, the broach cuts one corner of the square hole, and one-half way up each of the two adjacent sides, into the relief formed by the taper hole. A dog is fastened to the hub of the work, and the latter is mounted

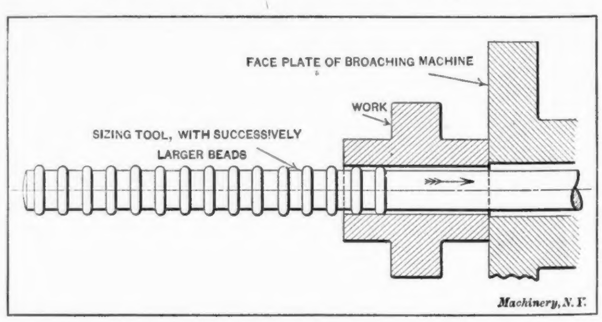


Fig. 11. Method of Sizing Phosphor-bronze in the Broaching Machine by Compression

on a taper plug fitting the hole, with the tail cf the dog located by a pin in the face-plate of the fixture, the latter being mounted on the face-plate cf the machine at an angle as shown, to agree with the angle of the corner of the tapered sides. This broaching operation was described in October, 1908, page 151.

One pass of the broach finishes one corner of the tapered hole. The broach is then returned to the starting position, the work is drawn off the taper plug, the dog indexed to the second pin on the face-plate, the work is put in position and the second corner broached. This operation is repeated until the four corners have been machined, and the square hole finished, the work being centered on the taper plug of the fixture throughout the whole operation. A taper square gage is shown lying on top of the broach in the engraving. This is used for testing the fit of the holes and the accuracy of the work, and a most accurate fit is made on this by no means easy operation. In the machine in the foreground, another operation is being done—that of broaching the driving slots in the driving clutch members for the multiple disks.

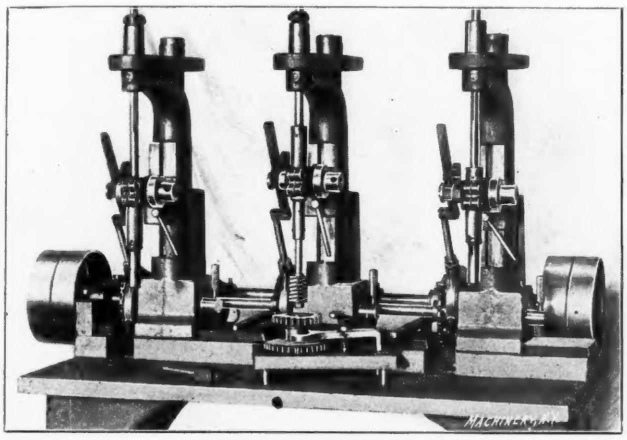


Fig. 12. Machine for Circular and Square Lapping Operations

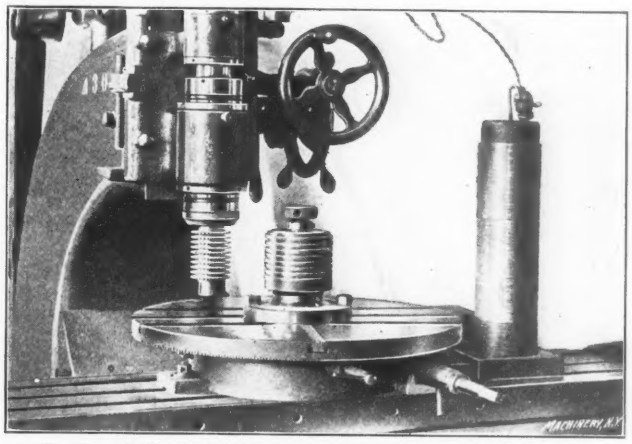


Fig. 13. Cutting out Piston Rings in the Vertical Milling Machine

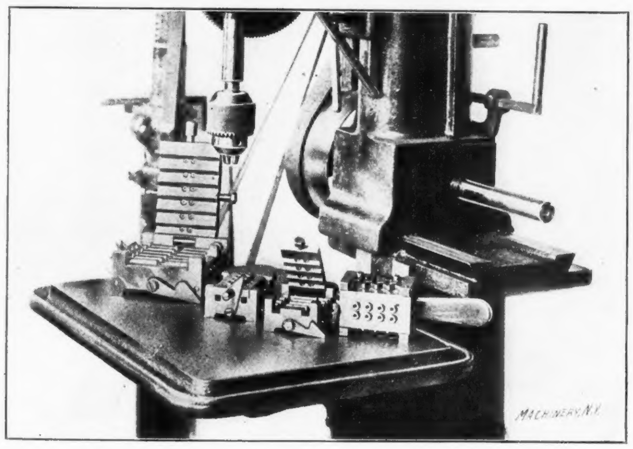


Fig. 14. Interesting Drill Jigs for a Simple Operation

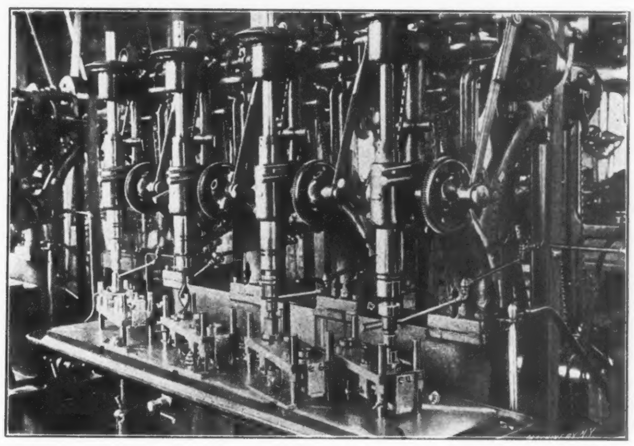


Fig. 15. Gang Drill used in Drilling and Reaming Connecting-rod Ends

Sizing Round Holes in the Broaching Machine

Another unusual operation for which the broaching machine is here used, is that of sizing holes in hard phosphor bronze bushings. This material, as any mechanic who has had any experience with it knows, is as hard on a finishing reamer as anything well can be. It is tough, elastic and slippery, and the less there is to ream the more difficult becomes the operation. Instead of reaming such holes, the tools shown in Fig. 11 are used in this shop. It will at once be seen that the operation is that of compressing the metal in the sides of the hole, until it has been enlarged to the finished size. The tool is drawn through the work. Each of the rounded rings or beads is a little larger than its predecessor, thus gradually compressing the metal the desired amount. The finished hole springs to a size smaller by some few thousandths than the diameter of the largest ring on the tool, so that the size of the latter has to be determined by experiment. This allowance varies slightly also, as may be imagined, with the thickness of the wall of metal being pressed. In such a part as that shown in Fig. 11, for instance, after drawing through the sizing tool in the broaching machine, it will be found that the hole will be somewhat larger in the large diameter of the work than in the hubs. It has been found that this difference in size can be practically avoided by passing the sizing tool through the work three or four times. Few pieces of this kind are found, however. The operation is a rapid one as compared with reaming.

An Adaptable Lapping Machine

The machine shown in Fig. 12 was built mainly in the factory, use being made, however, of the adjustable columns of a Taylor & Fenn sensitive drill press. This special machine is intended for lapping out the square holes of the drive, but is provided also with a rotary movement in addition to the vertical movement thus necessary, so as to provide for cylindrical lapping as well. The driving pulley at the right gives the reciprocating motion, while the pulley at the left rotates the spindles through the medium of the regular geared speed drive. The sprocket wheels shown, driven from the right, are loose on the driving shaft, and carry eccentrics whose rods are extended to form racks engaging, through a suitable clutch connection, the pinion shafts by which the spindle quills are fed up and down. It is thus possible to give a rotating and reciprocating movement to the spindles, either together or separately.

Separating Piston Rings

Another milling operation is shown in Fig. 13. It is a common practice to make piston rings on an automatic machine specially rigged up for the purpose, separating the rings from the finished casting by means of a series of parting or cutting-off tools, each of which is set a little in advance of the other so that the rings will cut off in regular succession. The parting tool, however, especially when used in severing cast iron work like this, having an eccentric bore, leaves a considerable burr. In the method of severing the rings shown here, the eccentric cylinder is first finished complete on the turret machine. Then it is mounted on an internal expansion chuck on the face-plate of the cylindrical attachment of the Becker vertical milling machine, as shown. This chuck is provided with clearance grooves for the gang of saws shown in the engraving. These are sunk into the cylinder, and then the

work is rapidly revolved, cutting out the eight rings at once. The saws are permanently mounted on their arbor, with separating collars ground to the proper thickness.

Examples of Fixtures used for Drill Press Operations

The drilling department seemed unusually small, when compared with the size of the whole plant, and gave the appearance of being worked at high pressure. The large output required was evidently maintained by the universal use of highly developed jigs for all manufacturing operations. Multiple spindle drill presses are used to almost the entire exclusion of the single spindle type.

Fig. 14 is interesting as showing the development in the jig for a comparatively simple operation—that of drilling

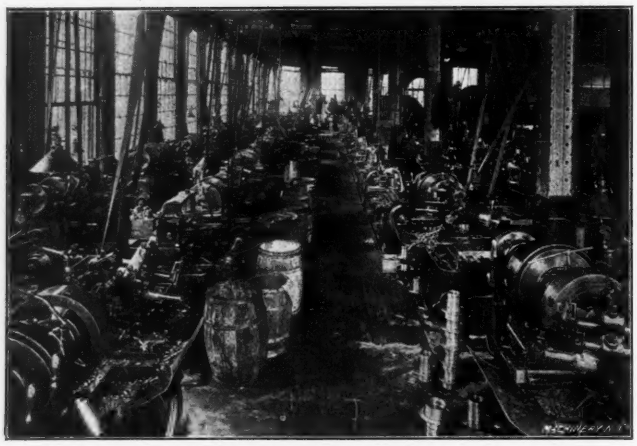


Fig. 16. An Unusual Array of Automatic Chucking Machines; Thirty-one are used in this Department.

the cotter pin hole in a headed cylindrical stud. In the first apparatus employed (not shown) the stud was pushed into a hole up to its head, and held there by a lever, one piece being done at a time. This rigging had two faults. One piece at a time is held, and trouble with chips and burrs was experienced, as might be imagined. An improvement on this device is shown in the two jigs at the right, where a base with a set of V's is provided in which several of the pins may be placed, their heads being pressed up against the end of the V-block by springs. The cover being clamped down on the work, the parts are thus held for the drilling operation. This, however, was not quite easy enough to clean to suit the ideas of the tool designer, so the fixture shown at the left was used for the next tool of this kind that had to be made. Here hinged sides are used instead of springs as in the previous

Fig. 17. The Engine Assembling Department

case. These sides fold up and press the heads of the work against the edges of the V-block. When they are turned down and the cover of the V-block is raised, the top surface of the V-block is all clear, so that the presence of chips shows inexcusable carelessness on the part of the operator. When the sides are folded up against the work and the cover is brought down, the latter, by means of wedge surfaces, presses the sides in, holding the heads of the work firmly in place and clamping them down on the V-block at the same time.

The jig shown at work in Fig. 15 is used for drilling and reaming the connecting-rod holes. It is of the "four-legged table" variety, with suitable clamps and hook bolts for taking the strain of the cut without permitting noticeable deflection and consequent inaccuracy in the work. A feature of the construction which is probably old enough, but was new to the writer, is the provision made for both drilling and reaming with a fixed bushing, thus avoiding the use of slip bushings of different diameters. For drilling, the jig is used as shown in the engraving, with the work clamped beneath the plate and the jig bushings above, guiding the drills. For reaming, the jig is reversed and a reamer is used having a pilot, which passes through the work into the jig bushing (now on the under side of the plate) by which it is guided.

Fig. 16 shows what is by long odds the largest aggregation of automatic chucking machines the writer has ever seen. There are thirty-one of the Potter & Johnston type. Practically every turned part not made in the screw machine from the bar is produced on these machines. That old standby, the engine lathe, appears to be about the rarest machine tool in the shop.

Fig. 17 shows a section of the engine assembling room. It will be noted that machine tools are few and far between, the only ones in sight being a drill press, speed lathe, and two or three grinding stands for sharpening tools. This shows that the manufacturing operations have been performed with great exactness. The question of assembly is simply one of bolting and screwing the separate parts together. The engines here shown are of the four- and six-cylinder type. The overhead trolley lines should be noted.

One of the most interesting departments in this factory is that for testing the completed engines. This, however, deserves an article by itself, and will be so treated in a future issue.

* * *

AN EARLY DEVELOPMENT OF INTERCHANGEABLE MANUFACTURING

An interesting feature of trading and manufacturing in Siberia, also common in European Russia, is mentioned in an article on Siberia in the September issue of *Cassiers' Magazine*. The system is referred to as the "Artel" system. The Artels are combinations of artisans, representing individual occupations and handicrafts, and are especially common in village communities. They are cooperative associations, the work being parceled out among the members and the profits on the work being divided among them in accordance with the rules of the Artel. The members carry on their work in their own cottages, much of the work being done in the winter time during the season when there is no work required for cultivating of the land. One common industry is that of making winnowing machines used by farmers for separating the grain from the chaff after threshing. These are sold in thousands, and are manufactured both in Russia and Siberia by these peasant associations. The machines are very satisfactory for their purpose, and are sold at an extremely low price, due to the system of manufacture followed by the Artels. Each man has a special part of the machine to make, and is provided with a templet for its making. The parts are produced in lots of hundreds and are brought together from the various workers and assembled by another group of workmen who have specialized in this part of the work. This system is exactly the same as that known to modern industries as the interchangeable plan of manufacturing, but it has been in vogue in Russia in the form just described long before it was thought of elsewhere. The trade in this particular machine is so enormous that more than one firm manufacturing agricultural machinery has endeavored to secure a portion of the business, but so far all have failed because no one has been able to produce and sell the machines at the price at which the Artels are able to sell them. Of course, it is only the very simplest machines that can thus be made by the Artels, and they are not able to extend their operations in directions where a higher degree of skill is required, but it is nevertheless interesting to note that the underlying principle of modern shop practice has been applied to the very crudest form of manufacture in countries usually considered so far removed from industrial progress as Russia and Siberia. The recognition and application of the principle are the important facts.

CHAPTERS IN THE EARLY HISTORY OF MACHINE TOOLS—2

JOSEPH G. HORNER*

In the lathe we see the earliest developments of machine tools, not only as the lathe and its allied forms are concerned, but because of the influence which this tool has had in the evolution of other types. The mandrel and its bearings occur in other machines, and the self-acting slide and tool-holder also, as well as many of the smaller details—lead screw,

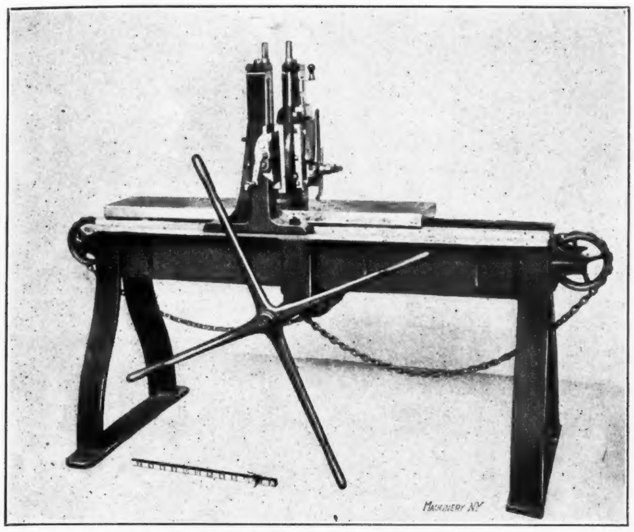


Fig. 8. Roberts Planing Machine, Table 52 inches Long by 11 inches Wide (1817), South Kensington Museum

change gears, feed rods, methods of take-up, and so forth. The lathe preceded all other tools and influenced their design.

Planing Machines

After the slide-rest had become developed into a traveling element the principle was not long in being applied to other

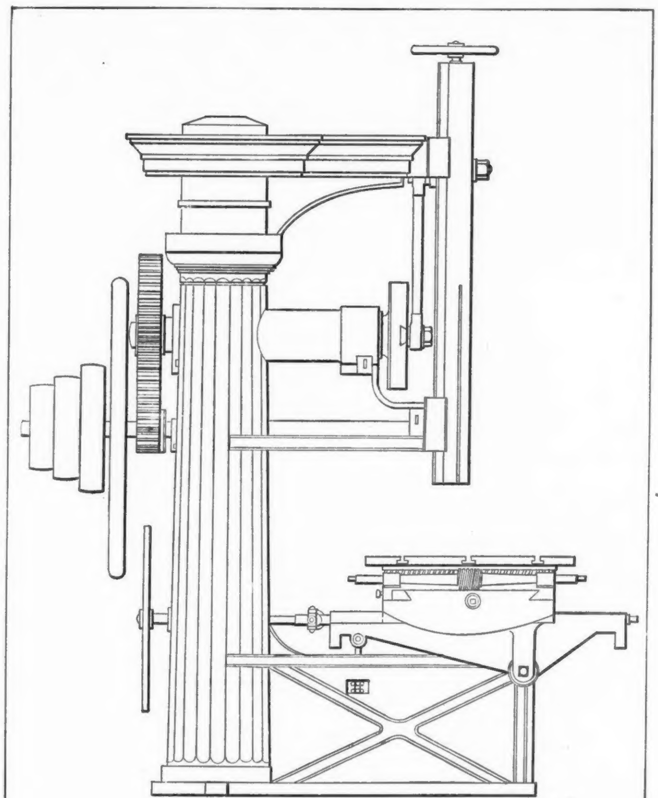


Fig. 9. Self-acting Slotting Machine, Caird & Co., Greenock (about 1846)

machines. First came the planing machine, pioneer of a long line of machines, the principal value of which is due to the coercion exercised on the tool by the sliding action. The honor of its invention appears to lie between four claimants, Roberts, Clements, Fox, and Murray, working during the period of about 1814-1820. This was a very prolific epoch in the history of machine tools; an age of great inventors, pupils, and followers of Bramah and Maudslay.

The planing machine by Richard Roberts of Manchester, now in the South Kensington Museum, Fig. 8, still bears evidence of the hand work done in fitting it up. It is chain-driven, the chain passing round a drum underneath, about the center, going thence over guide pulleys at each end, and attached to each end of the bed. The movements were operated by the large cross handle seen on the axis of the drum. The bed is cast in two parts, of angle section, bracketed and bolted to the legs. Its top edges are inverted vees, doubtless made thus with the intention of preventing lodgment of the chips.

The upper work is remarkable from the fact that the tool-holder is nearly as large as the standards. These are castings slotted on the front for the clamping of the cross-slide. This is elevated by means of independent screws. The tool-slide is traversed by a feed screw.

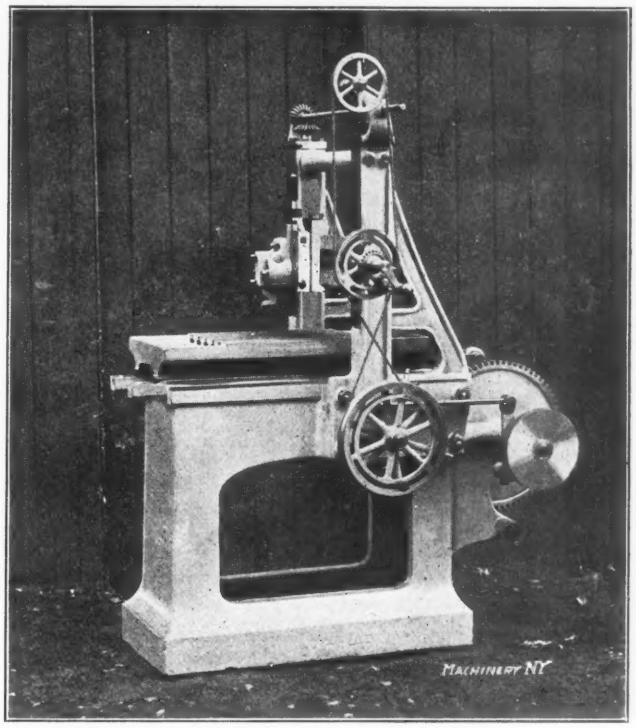


Fig. 10. Whitworth Crank-driven Planer (1868)

During the decade 1830-1840 the demand for high-class machine tools became pressing and extensive, due largely to railway developments. The firm of Sharp, Roberts & Co. was one of the earliest in the field. It had been in existence since 1828, having been engaged in the construction of cotton spinning machinery in Manchester. Roberts was the inventor of the firm, and he designed many lathes, machines for planing, slotting, the cutting of wheel teeth, punching and shearing. Roberts is credited with having invented the system of templets and gages to secure interchangeability of parts in locomotives. This last would be subsequent to 1834, when Sharp, Roberts & Co. started the Atlas Works.

Whitworth stands out a giant among the giants of the time, and his work has eclipsed in poular estimation that of most of his compeers. The period of his activities is marked by numerous improvements and inventions. But the three which have left the most lasting results are the standardization of screw threads, the method of production of a true plane, and measurement by micrometer instruments and by fixed gages. These were the advances which rendered accurate mechanical construction possible. They have been largely instrumental in the displacement of hand work in the construction of machines. They were the incentives to later developments, and they have in some degree dwarfed Whitworth's work in the improved designs of machine tools, or perhaps less attention has been attracted to these. But these are nevertheless very prolific and very interesting. His work has stood the test of time so well that most of the inventions and improvements which he devised have never been superseded. Machines, methods of manufacture, standardization,

* Address: 45 Sydney Building, Bath, England.

measurement, and test, bear the impress of his genius; and the great firm which he founded still fully maintains the old traditions and high reputation of its originator.

Whitworth seems to have been the first to design that form of planer in which the work remains stationary while the tool travels. He had patented a machine of this kind in

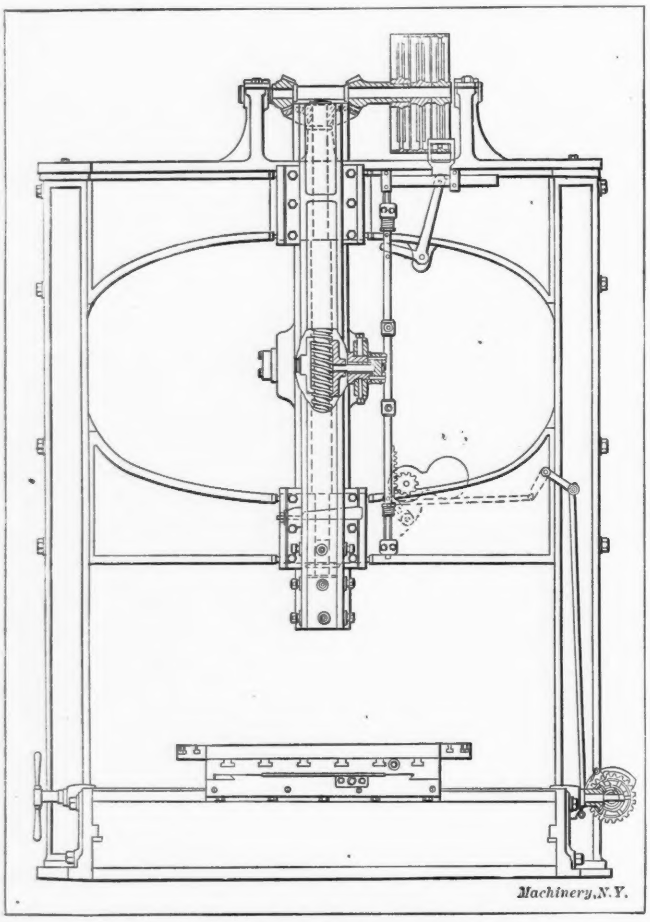


Fig. 11. Slotting Machine, Screw-driven. Front Elevation. Joseph Whitworth & Co.

1835, in which the side frames carrying the cross-rail traveled on large wheels on rails low down on each side of the fixed work table.

This Whitworth planer of 1835 was very skeleton-like, if judged by our standards, as indeed all the early tools were; but the resemblances to some features of present-day machines are striking. The lightness of build is illustrated by the fact that flanges were cast on the outside of the framing, and flanges on the traveling heads came just underneath them, with the object of preventing the traveling mechanism from tipping under heavy duty!

Being a traveling head machine, provision was made by three sets of flanges forming ledges within the cheeks for receiving the work tables at three different heights. The cross-rail was elevated by vertical screws and bevel gears, and the cross-slide could be bolted at any height on the face of the uprights.

The crude beginning of the screw worm drive which Whitworth subsequently used on the planers and drilling machines may be traced to this early machine. Two square-threaded screws ran alongside, one flanking each upright and reversing the travel at equal rates. The two side screws were driven from bevel wheels, the transverse shaft having three reversing bevel wheels with claw clutches at the center. Curious recessed rollers were used to transmit the motion of the screw to the uprights, the edges of the rollers, which were set at any angle, entering into the thread spaces. From this device the worm-wheel engagement would naturally follow in time, as it did.

This machine embodied also the reversible tool-box in a crude form, but reversed similarly to later ones by means of a cord round a pulley. The pulley was not in the axis of the rotating box, but on a spindle in front, whence the movement was transmitted through spur gears. The down-feed was accomplished through ratchet mechanism acting on a screw at the head of the tool holder.

In 1837 Whitworth modified the tool-box, introducing the cam groove cut on the rotating body, and which when acted on by a pin operated by the vertical movement of the feed rod imparted the rotary movement. This device has remained permanently embodied in the firm's planer tool boxes of this type.

The fitting of two tools in the box to avoid the rotation of the holder was patented by John Roberts in 1838. In its essentials it is like double cutting holders of to-day, the box being pivoted to throw off the tool which is not in action.

The design of planing machine which has come into considerable prominence lately, in which the tool is reciprocated instead of the work, was being worked out about 1840 by M. Decostre, of Paris, M. Cave and Mr. Hick of Bolton. The first was chain operated, the second by means of a leather belt, the third by a steel belt. In M. Decostre's machine two endless chains were used running the whole length of the machine. The bed was V-grooved, carrying supports, and a cross-rail with the tool-holder. In the machine of M. Cave an endless belt ran over fixed and tension pulleys communicating motion through gears to two racks.

The planing machine had been nearly crystallized in its present design in the forties. The method of driving still lay between rack and screw, for Whitworth had then applied the screw drive to both planing and slotting machines. Quick return in rack-driven machines was effected by larger and smaller fast and loose pulleys driving through gears to the rack pinion. There were three designs of racks then. There

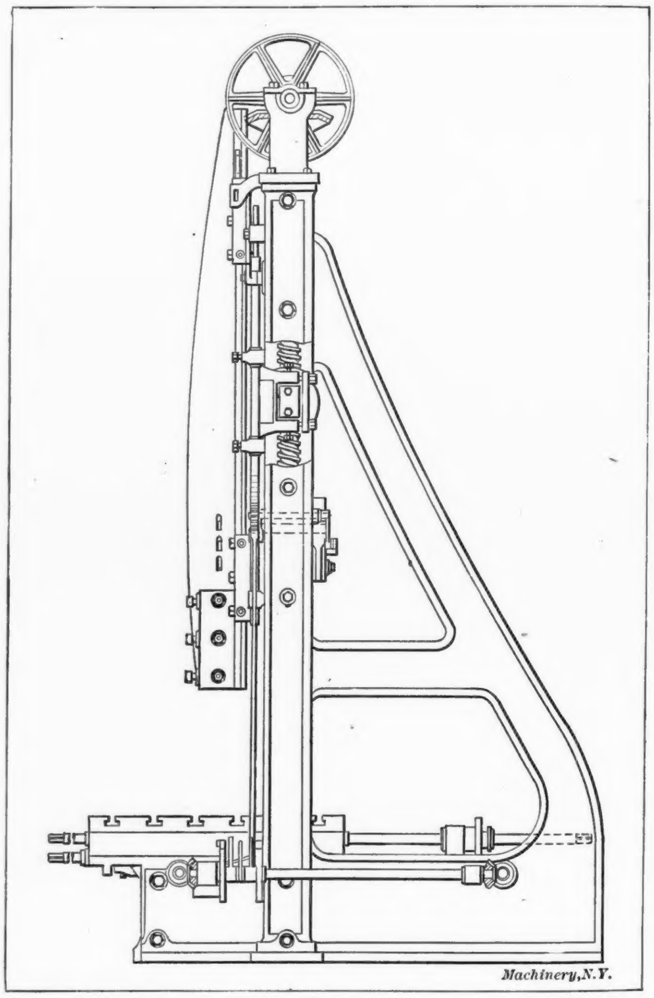


Fig. 12. Early Self-acting Slotting Machine, Screw-driven. Side Elevation. Joseph Whitworth & Co.

was the simple single rack, there were the two racks bolted to the under side of the traveling table with the teeth set to hit-and-miss, and there was the stepped rack with three steps, each step having its teeth equal in length of face to one-third the width of the rack, being set behind its fellow at a distance equal to one-third of the pitch. This was introduced by a Mr. Collier of Manchester.

To the screw reversal the objection was that the return speed was not accelerated, the bevel wheels being of equal sizes. Mr. Shanks of Johnstone modified the gear by placing two bevel wheels of different sizes on the end of the screw, the diameters of which bore the same relation to each other as the speeds of cutting and reverse did. These were operated by pinions on solid and hollow shafts, and the device has been fitted to many machines.

The earliest Whitworth screw did not engage with nuts as at present, but with worm-wheels, being the same device as the rack worm-wheel applied to the lathe lead screw, but duplicated. Two worm-wheels on opposite sides of the screw, and having their spindle bearings secured to the under side of the table, were revolved by the rotation of the screw, and thus carried the table along. The same method was applied to the spindles of drilling machines. The device was first applied by Whitworth in 1835 for the motion of the carriage of a self-acting spinning mule.

A favorite type of small planing machine in and around the Manchester district is the crank-driven design. One of these of date of 1868 by Whitworth & Co. is shown in Fig. 10. It is driven by a cone pulley through crank-pin and slotted link, adjustable for stroke, and giving quick return. The slotted link is provided with a connecting-rod, one end of which is attached to the table. The feed is operated from an edge cam keyed to the crankshaft. This rotates at each end of the stroke through bevel gears the cord pulley at the bottom of the upright. The cord fixed to this pulley passes round the several pulleys shown, and gives a variable horizontal feed by means of the ratchet gear on the end of the cross-slide, and a variable vertical and angular feed by ratchet gear on top of the tool slide.

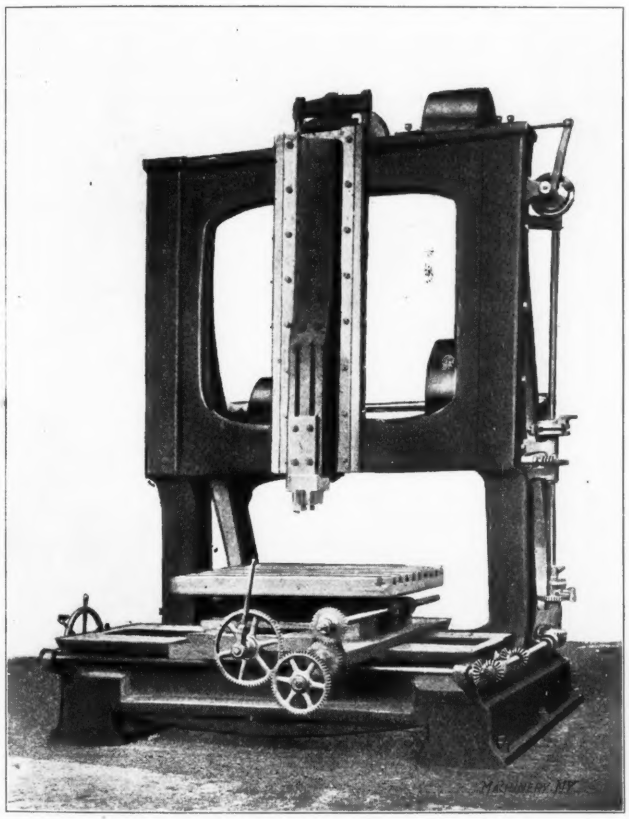


Fig. 13. Slotting Machine. Joseph Whitworth & Co. (1874)

At an early period the American planing machines were improved and developed on different lines from the English ones. Some of the early chain machines remained in use in England, and in the States as late as about 1880, side by side with many of the improved forms which are even now regarded as modern. The Sellers' drive was then in existence —the spiral pinion working diagonally in its rack, an improved form of Bodmer's worm and rack. The rack-and-pinion drive was also in use. The plain rack and the stepped rack divided favor in England, but the pinion was always small, with a tendency to lift the table. The large driving or bull wheel was early adopted in America. The single belt for driving and reversing was early abandoned in America for two belts, one driving, the other for reversing; and high speeds and narrow belts also were adopted, and the shifting of one belt at a time. The feed gear was operated from the driving gears instead of by tappets on the table.

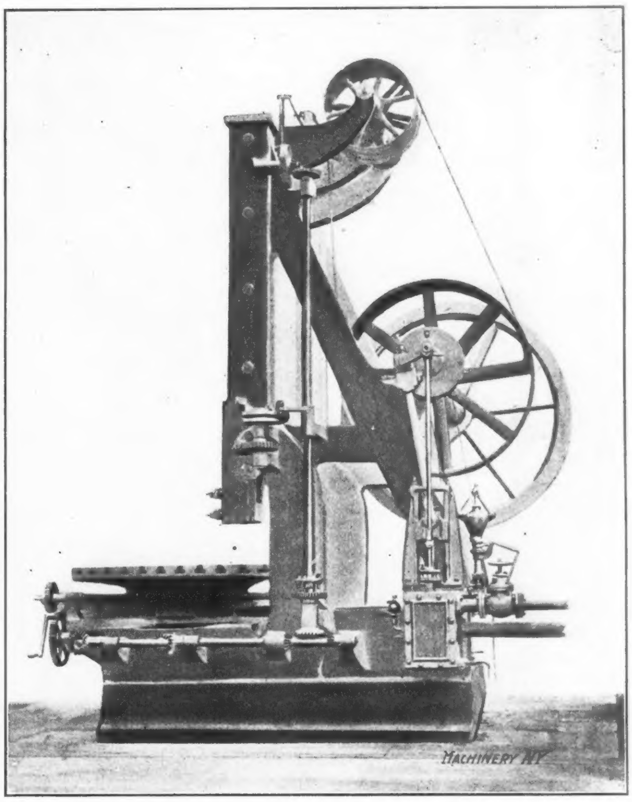


Fig. 14. Slotter driven by Steam Engine. Joseph Whitworth & Co. (1867)

Mr. Richards has a hit in an old pamphlet at the ornamentation which was a common feature in early machine tools. He said "The strains that fall upon the standards of planing machines are so obvious that there should be no difficulty in determining the best form; but these standards offer so inviting a field for architectural ornament that only a few tool makers forbear adding some filigree work. The beads, moldings, and ornaments of cast-iron machine parts were long ago discarded by the better class of engineers, and are at present seldom seen except in New England or in France.

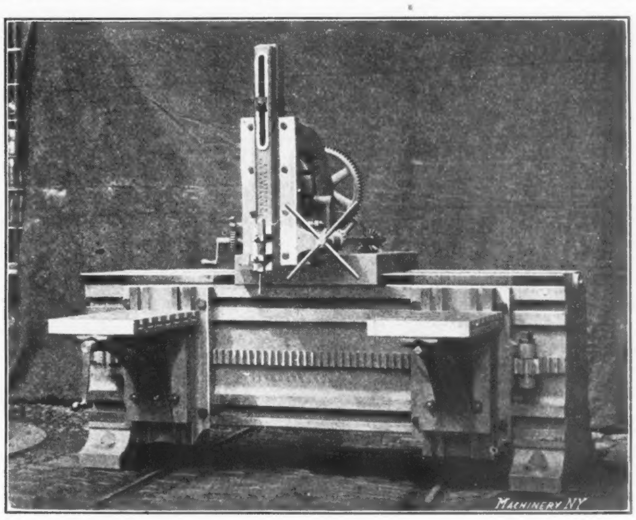


Fig. 15. Special Slotting Machine with Lateral Feed. Joseph Whitworth & Co. (1865)

As a rule the want of good fitting and want of true proportions in machine tools is directly in proportion to the amount of attempted ornament."

Three large wall planing machines were among the equipment at Soho. The largest covered a wall space of 27 feet by 9 feet. The traversing screw was 4 inches diameter, of ⅝-inch pitch, double threaded, and the nut of 2 feet in length embraced only the upper part of the screw. An interesting feature was the double cutting tool-box of the rocking type

reversed by a trip lever, and it carried four tools, two facing in each direction.

The Richards side planers were first described in a pamphlet printed in Philadelphia in 1882. They are there termed combination, or compound planing machines, because they perform the functions of both planing and shaping machines, and the features there described, now familiar, had the claim of novelty: "The time required to fasten work is not one-half as much as with a common machine. The tools always operate at the same level, and the range of movement is nearly as accurate as with crank motion. The stroke is as complete at 2 inches as at 50 inches." The entire absence of gear wheels is mentioned, and the noiselessness of running. Two sizes of machines only were made at first, one to plane 50 inches by 20 inches, weighing two tons; the other to plane 60 inches by 25 inches, and weighing three and a half tons. Mr. J. Richards, who did so much for machine tool development in America, early advocated the fixed work, and the traveling tool embodied in his side planer. He said in a paper published in San Francisco in 1880: "When work becomes many times as heavy as the implements required to cut it, there are good reasons for moving the tools instead of the piece. The principle is traceable through all machine tool practice of our day, but is especially marked in the case of planing appliances. Mammoth machines with running platens to plane eight, ten, or twelve feet square are now seldom made except in this country. Four feet square may be called an economic limit for moving platen machines. . . . A large sole plate with portable tools for planing and boring is in most cases all that is required."

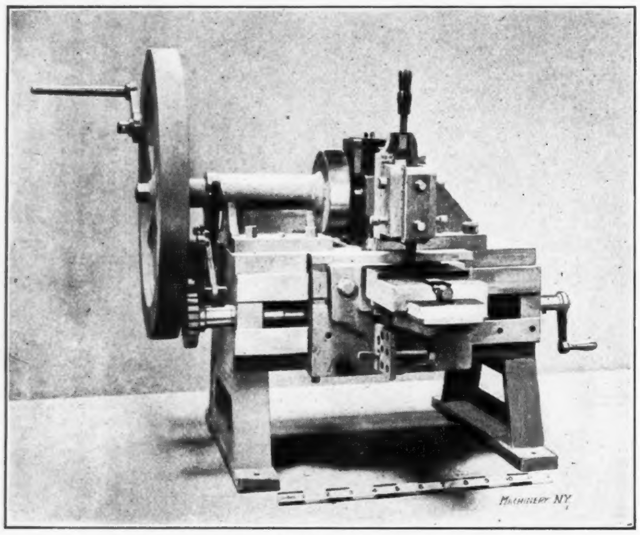


Fig. 16. Shaping Machine designed by James Nasmyth. South Kensington Museum

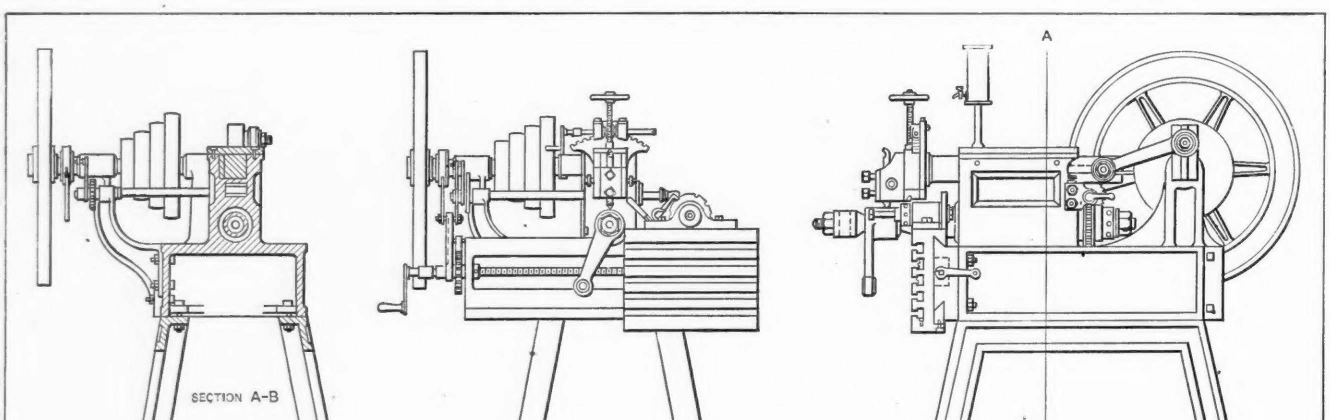


Fig. 17. Compound Planing Machine or Shaper. Nasmyth & Gaskell

Slotting Machines

The slotting machine was invented by Richard Roberts, but the idea was borrowed from a machine by Maudslay used for cutting the mortises in ship's blocks. Roberts' machine was in general appearance and design similar to present-day machines, but there was no quick return. Nasmyth, seeing the objection to the limitations in diameter due to the presence of the gap, designed in 1836 a table machine in which the slotting ram was placed below in a pit. The advantages which he claimed were that it was capable of operating upon wheels of any diameter, that it would take a much deeper cut, there being an entire absence of any source of springing or elasticity in its structure, that it operated with more precision, occupied less space, and did not cost above one-third of the other machines. This might be regarded as the prototype of the keyway seating machines.

There was a slotting machine at Soho foundry attached, like so many of the machine tools there, to the wall. The baseplate, with table and slides was on the floor. The ram moved in dovetailed slides, and was driven by a single threaded screw of 4½ inches diameter and 1 inch pitch, the cutting and return movements being effected by a nest of bevel gears at the top of the machine. The screw ran in a nut at the head of the ram, the weight of which was counterbalanced. Power feeds were fitted to the table slides.

The early form of slotting machine was obviously an adaptation of the planer, but crank-driven. Though it had no quick return, and no self-acting table feeds it had the two rectilinear and the circular movements imparted by hand, and a tilting table, and thus marked a very great advance in the methods of the machine shop. An example by Caird & Co., Fig. 9, previous to 1847, is curious for its architectural features, its fluted column, and architrave on the overhanging head.

One of Whitworth's early slotting machines with the ram, screw-driven as previously mentioned, Figs. 11 and 12, avoided the difficulty of the obstruction of the standard by employing two uprights bolted to the base, and leaving a clear space between them from front to back. Two stretchers bolted between the uprights provided the guides for the ram. Fig. 13 is a similar machine of date 1874.

Among the tools at the old Lambeth works was a slotting machine by Sharp, Roberts & Co. of Manchester, bearing date 1840. The framing was arched at the top. A six-stepped belt cone drove the ram through a slotted crank and connecting-rod arranged at the back, but at the side of the main frame, which was a very skeleton-like affair. The table was provided with all motions, including the circular, and an elevating motion of its base between the main framing. Feed was self-acting from a cam on the cone shaft. A trunnion fitting to the table provided for taper slotting.

A large Whitworth slotting machine (1867) for general and locomotive work is shown in Fig. 14, driven by a steam engine with governor attached. The stroke was about 4 feet. The tool ram is actuated by means of a quick threaded screw from the drum of the engine crankshaft by shifting belt to top pulleys, thence through bevel gear for the cutting stroke, and miters for quick return. The bottom of the main screw is

fitted with small bevel gears giving motion to a worm and worm wheel which rotates the slotted disk. This is provided with tappets adjustable for length and position of stroke. The tappets actuate the long vertical shaft, the top of which is coupled to the belt striking gear, and the bottom to the variable reversible feed motion in the longitudinal, transverse, and circular directions. The table is 6 feet 6 inches diameter and the distance between the uprights is 8 feet 6 inches.

A Whitworth machine which embodies features of the shaper and slotter is shown in Fig. 15. It was a special slotting machine (1865) made for slotting out the port holes in the cylinders of locomotives, and doing ordinary work on the table of the machine. The tool ram is driven from a balanced counter-shaft by means of the single pulley seen at the back of the head, thence through the spur gears, slotted disk, and connecting-rod, adjustments for length and position of stroke being provided for. The variable feed is operated from an edge cam on the disk shaft through the slotted lever seen on the right-hand side of the head; thence by ratchet wheel, miter wheels, and revolving nut on the screw in the bed, for longitudinal feed; and by the left-hand ratchet gear, miter, and screw, for the transverse feed.

Shaping Machines

Nasmyth invented the shaping machine in 1836 with the object of tooling the smaller details which were not suitable to go on the planing machines. It was known as "Nasmyth's steam arm," of which the arbor for segmental work formed an important element. Said he: "None but those who have had ample opportunities of watching the progress of executing the detail parts of machines can form a correct idea of the great amount of time that is practically wasted and unproductive, even when highly skilled and careful workmen are employed. They have so frequently to stop working in order to examine the work in hand, to use the straightedge, the square, or the calipers, to ascertain whether they are 'working correctly.' During that interval the work is making no progress; and the loss of time on this account is not less than one sixth of the working hours, and sometimes much more; though all this lost time is fully paid for in wages."

An early form of the Nasmyth shaper, hand operated, is in South Kensington, Fig. 16. A somewhat later design, power driven, is illustrated by the drawing Fig. 17. This was termed a compound machine, because it included circular tooling on the mandrel, which did away with a deal of hand chipping and filing on lever ends and similar work. It had no quick return at first. Whitworth was the first to fit that. It was just a short stroke machine substantially like present day successors only of rather bizarre appearance. It was belt-driven on cones, with adjustable stroke and self-acting feed to the arbor.

Yet the original of the shaper may be traced to a machine in Maudslay's shop. Two girders supported on legs carried the sliding work bed, over which the the tool-box was traversed and reciprocated between two round bar guides. These movements were derived from a large cord-driven stepped pulley, crank and connecting-rod, to the tool-box. The latter with its guides could be adjusted vertically by four screwed pillars, with nuts above and below the bosses of the guide bars which fitted over the pillars. An interesting feature is that the tool box was rotated through 180 degrees at the end of each stroke, to cut on each stroke.

* * *

The question of supplying power to Paris by means of an electric generating plant at the Rhone falls now appears to have reached the stage of probability. It is planned to transmit 150,000 kilowatts direct current at a voltage of from 120,000 to 200,000, although there is doubt on the question whether the three-phase system would not be preferable. The capital cost for the whole project is estimated at $20,000,000 and an important factor yet to be decided is whether it will be possible to deliver current at the capital at lower cost than when generating locally by steam. It is, however, probable that manufacturing towns would grow up around the falls, similarly as has been the case around Niagara, and in this case the project of establishing a large power station would be entirely feasible.

STRESSES PRODUCED BY SHOCKS

A. P. ELTOFT*

A. P. Eltoft†

The opinion that, in general, a certain static load can be substituted for a shock produced by a body in motion, is often met with among engineers. This opinion, however, is true only within certain limitations; that is to say, in each concrete case there exists a certain force which will produce the same maximum stress as that due to a given shock, but this force may vary greatly in different cases even if the energy, by which the shock is measured, remains the same. The magnitude of a shock must be measured in units of energy, and, therefore, cannot be directly compared to a force.

Although in some cases a close approximation to an exact calculation of stresses produced by shocks may be attained, it is often found a complicated, and sometimes an impossible, task to determine, even theoretically, the effects of a shock, and the object of the present article is more to give a clearer understanding of the principles involved, than an attempt at exact calculation.

TABLE I. STRESSES PRODUCED IN BEAMS BY SHOCKS

Method of Support, and Point Struck by Falling Body.	Fiber Stress p produced by Weight Q dropped through a Distance h.	Approximate Value of p.
Supported at both ends; struck in center.	$p = \frac{QaL}{4I}\left(1 + \sqrt{1 + \frac{96hEI}{QL^3}}\right)$	$p = a\sqrt{\frac{6QhE}{LI}}$
Fixed at one end; struck at the other.	$p = \frac{QaL}{I}\left(1 + \sqrt{1 + \frac{6hEI}{QL^3}}\right)$	$p = a\sqrt{\frac{6QhE}{LI}}$
Fixed at both ends; struck in center.	$p = \frac{QaL}{8I}\left(1 + \sqrt{1 + \frac{384hEI}{QL^3}}\right)$	$p = a\sqrt{\frac{6QhE}{LI}}$

I = moment of inertia of section; a = distance of extreme fiber from neutral axis; L = length of beam: E = modulus of elasticity.

A number of formulas, however, are included, because many interesting conclusions can be drawn directly from these formulas, which probably also will be of interest to many of the readers of MACHINERY, who, like the writer, have often felt the need of some formulas directly applicable to shocks.

Any elastic structure subjected to a shock will deflect until the product of the average resistance, developed by the deflection, and the distance through which it has been overcome has reached a value equal to the energy of the shock. It follows that for a given shock, the average resisting stresses are inversely proportional to the deflection. If the structure were perfectly rigid, the deflection would be 0, and the stress infinite. The effect of a shock is therefore to a great extent dependent upon the elastic property (the springiness) of the structure subjected to the impact.

The energy of a body in motion, such as a falling body, may be spent in each of four ways:

1. In deforming the body struck as a whole.
2. In deforming the falling body as a whole.
3. In partial deformation of both bodies on the surface of contact (most of this energy will be transformed into heat).
4. Part of the energy will be taken up by the supports, if these be not perfectly rigid and inelastic.

How much energy is spent in the last three ways it is in most cases difficult to determine, and for this very reason it

* Address: 6628 Loomis St., Chicago, Ill.

† A. P. Eltoft is a graduate of the Polytechnic Institute of Copenhagen, Denmark. He has been employed by the Reno Inclined Elevator Co., New York, and the American Bridge Co., Chicago, and for the last four years has been estimator for the Link Belt Co., Chicago.

is safest to figure as if the whole amount were spent, as in case 1. In cases where a reliable judgment is possible, as to what percentage of the energy is spent in other ways than the first, a corresponding fraction of the total energy can be assumed as developing stresses in the body subjected to shocks.

Formulas for Stresses due to Shocks

If, in the accompanying illustration, the weight Q be dropped from a height h to the end of a bar of the length L and cross sectional area A, then the static load P which would produce the same elongation as the maximum elongation produced by the dropping of Q, would be determined by the following formula:

$$P = Q\left(1 + \sqrt{1 + \frac{2hAE}{QL}}\right) \qquad (1)$$

For $h = 0$ this gives $P = 2Q$, or a suddenly applied load will produce the same elongation and therefore the same stress as a static load twice as great.

If the elongation y of the bar is small compared to the height h, the formula may approximately be written

$$P = \sqrt{\frac{2QhEA}{L}} \qquad (2)$$

If the unit stress $p = \dfrac{P}{A}$ be introduced in this formula, we get

$$p = \sqrt{\frac{2QhE}{LA}} \qquad (3)$$

From this formula, the interesting conclusion can be drawn that the unit stress p for a given load producing a

TABLE II. STRESSES PRODUCED IN SPRINGS BY SHOCKS.

Form of Bar from which Spring is made.	Fiber Stress f produced by Weight Q dropped a Height h on a Helical Spring.	Approximate Value of f
Round	$f = \dfrac{8QD}{\pi d^3}\left(1 + \sqrt{1 + \dfrac{Ghd^4}{4QD^3n}}\right)$	$1.27\sqrt{\dfrac{QhG}{Dd^2n}}$
Square	$f = \dfrac{9QD}{4d^3}\left(1 + \sqrt{1 + \dfrac{Ghd^4}{0.9\pi QD^3n}}\right)$	$1.34\sqrt{\dfrac{QhG}{Dd^2n}}$

G = modulus of elasticity for torsion; d = diameter or side of bar; D = mean diameter of spring; n = number of coils in spring.

shock, varies directly as the square root of the modulus of elasticity E, and inversely as the square root of the length L of the rod and the area of section A. Thus, for instance, if the sectional area of a column be increased four times, the unit stress will diminish only one-half. This is entirely different from the results produced by static loads where the stress would vary inversely with the area, and within certain limits be practically independent of the modulus of elasticity and the length L of the rod.

Similar formulas may be developed for stresses produced by shocks in beams or other members subjected to bending, and supported in various ways. The accompanying Table I gives the unit stress p in beams of length L produced by a weight Q falling a distance h. Only the simplest cases have been considered. It is interesting to note that the approximate value of the stress produced by the shock is the same, irrespective of how the beam is supported. This again shows how the effects of shocks and the static load differ. As a matter of fact, the expression for the approximate value of p will be the same for beams supported on both ends and subjected to a shock at any point between the supports.

Effect of Shocks on Helical Springs made from Round or Square Bars

A load suddenly applied on a spring will produce the same deflection, and therefore also the same unit stress as a static load twice as great. If, however, the load Q falls from a height h before striking the spring, it will produce a stress equal to that of static load P, according to the formula:

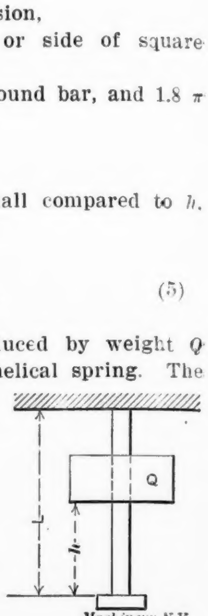
$$P = Q\left(1 + \sqrt{1 + \frac{2hGd^4}{CQD^3n}}\right) \qquad (4)$$

in which G = modulus of elasticity for torsion,
d = diameter of round spring or side of square spring,
C = a constant, which is 8 for round bar, and $1.8\,\pi$ for square bar,
D = mean diameter of spring,
n = number of coils in spring.

If the deflection y of the spring is small compared to h, an approximate formula may be written

$$P = \sqrt{\frac{2QhGd^4}{CD^3n}} \qquad (5)$$

Table II gives the fiber stress f produced by weight Q dropped a distance h before striking a helical spring. The main conclusion arrived at in these formulas is that the fiber stress for a given shock will be greater in a spring made from square bar, than in one made from a round bar, if the diameter of coil be the same, and the side of the square bar equal the diameter of the round bar. It is, therefore, decidedly more economical to use round stock for springs which must withstand shocks. This is due to the fact that the deflection for the same fiber stress for a square bar spring is smaller than that for round bar spring, the ratio being as 4 to 5. The round bar spring is therefore capable of storing more energy than a square bar spring for the same stress.



Stress due to Shock

Shocks from Bodies in Motion

The formulas previously given can be applied, in general, to shocks from bodies in motion. A body of the weight W moving horizontally with the velocity of v feet per second, has a stored up energy

$$A = \frac{1}{2}\frac{Wv^2}{g} \text{ foot-pounds, or } \frac{6Wv^2}{g} \text{ inch-pounds.}$$

This expression may be substituted for Qh in the previous equations for unit stresses containing this quantity, and the stresses produced by the energy of the moving body thereby determined. The formulas in this case are no longer approximate, but correct, as there is no work corresponding to Qy.

It will be noticed that in all these formulas, the stress is directly proportional to the square root of the energy consumed. Therefore, if it is assumed that only a certain percentage, as p per cent of the energy developed, is consumed, then the stress will be diminished from the first value obtained, to the first value multiplied by $\sqrt{\dfrac{p}{100}}$

The writer is fully aware of the limitations of the applications of the formulas given. They give, however, a maximum value of the stresses, thus giving the designer something definite to guide him even in cases where he may be justified in assuming that only a part of the energy of the shock is taken up by the member considered. If the quantity Qh be taken as representing the energy consumed by the member in question, then the formulas are perfectly correct. The conclusions drawn, therefore, hold good, as for this purpose, no other significance need be given to the quantity Qh. The deductions of the formulas given have not been included, as these deductions are rather lengthy. They are, however, all deduced by the simple principle that the work performed by the weight Q acting through a certain distance must equal the work consumed by the internal stresses. The work performed by the weight, of course, is the weight multiplied by the distance through which it falls before striking the body plus the amount of deflection. The work of the internal stresses equals the mean stress produced by the shock times the deflection. This mean stress is ½ of the maximum stress, or the stress P produced by the maximum deflection.

AUTOMOBILE FACTORY PRACTICE*

THE DAYTON MOTOR CAR CO., DAYTON, OHIO

ETHAN VIALL†

The recent hard times, as many in the machine tool line have known them, have as a rule, been regarded as a huge joke by the big automobile builders, for a large majority of them have run full or double time and then could not fill all their orders promptly. So far behind have many of them been that they had to get some of the parts made elsewhere, and the Dayton Motor Car Co., Dayton, Ohio, maker of the Stoddard-Dayton automobiles, has been no exception in this respect. In fact, the company has found it necessary to extend its plant by the erection of an immense steel and concrete structure, now nearing completion, that will nearly double its already tremendous capacity.

This firm actually makes, as the word is understood in the manufacturing world, about 95 per cent of its car, which is a high percentage when one considers the average automobile shop, or even some of those of national reputation, which in many cases are little more than assembling plants. The firms in the same class with the Dayton Motor Car Co., when it comes either to size, methods, quality, or output can be numbered on the fingers, with several to spare. The forging department alone is as large as some good-sized factories. Here everything in the nature of a forging which is used on the automobiles, with the exception of the crank-shaft, is made; even the big elliptical side springs are made up complete in this department from the plain steel strips to the finished article which is tested out in actual service.

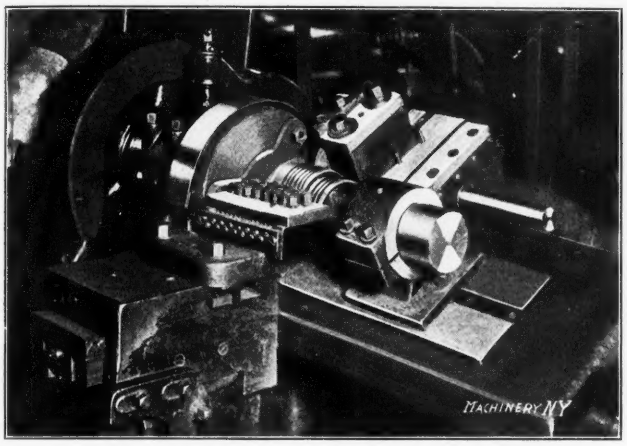


Fig. 1. Turning, Boring and Cutting-off Piston Rings in a Gridley Machine

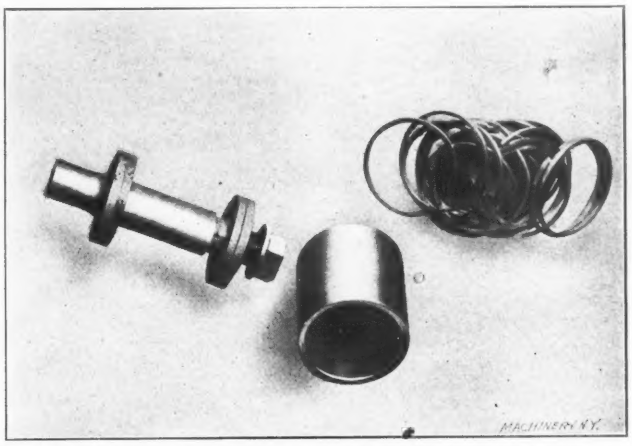


Fig. 2. Mandrel for Holding Rings when Grinding the Outside

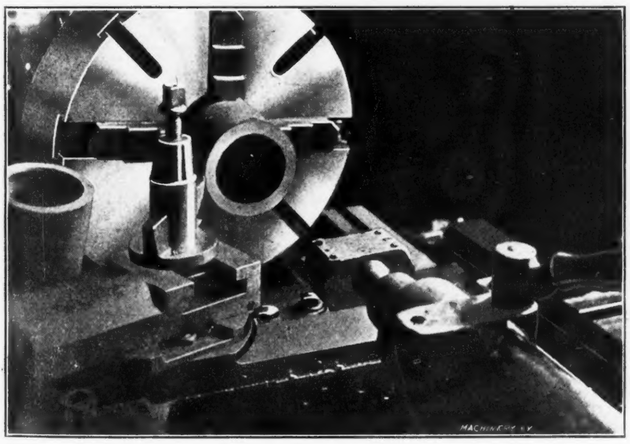


Fig. 3. Facing the End, breaking the Inside Edge and boring out the Piston

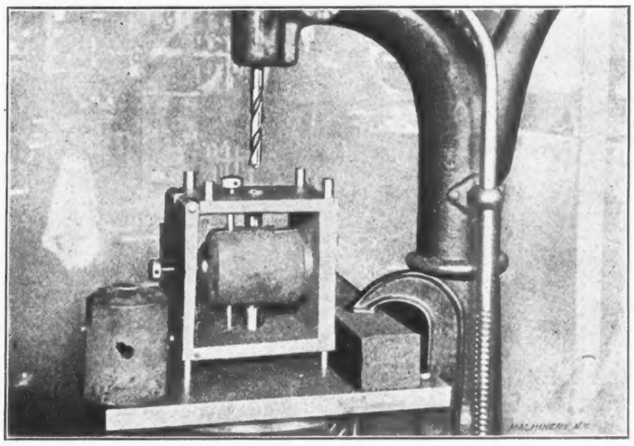


Fig. 4. Jig for Drilling the Wrist-pin Hole in the Piston

This firm is also one of the few which has its own foundry, thus insuring a more nearly uniform product than can be obtained from a jobber. Then, too, the body tops are cut, sewed and finished and cushions are made in their respective departments. Wood is bent into shape for the bodies and top braces and, of course, all painting and finishing is done in the plant. There is, besides the complete line of manufacturing departments, a big garage and repair shop maintained especially for the quick repairing of disabled machines of their own make that may be shipped or brought in.

Crowded as are the conditions in the factory just at present, the shop practice itself stands out clear and strong, the equal of anything in the country. This does not mean that every machine is original or built especially for the work to be done, for at the present stage of the automobile business this is no longer necessary, but where special machines or tools have been needed they have been built, and built in a way that speaks well for their efficiency and length of usefulness.

The most vital part of an automobile is the motor and it is around this part of the machine that the interest of a mechanic usually centers. Many of the parts cannot, for lack of space, be followed through the various routes they take in the shop, but the practice of different factories varies to such an extent regarding piston rings, pistons and cylinders, that these parts will be taken up pretty much in detail, and a few other more or less important or interesting points will also be touched upon.

Making Piston Rings

Piston rings go through comparatively few separate operations, as three of the operations are done simultaneously on one machine. The piston-ring casting is made with three large flanges or lugs on one end for the purpose of bolting it to the face-plate. The holes in these lugs are laid out by hand and drilled in a drill press and the casting is then bolted to the face-plate of a Gridley semi-automatic piston ring machine which is shown in Fig. 1. This machine bores out, turns eccentric and cuts off the rings, all the operations going on at once. The motion of the turning-tool carriage which turns the outside of the casting eccentric while the inside is bored concentric, is obtained by a cam on the back of the face-plate. After leaving this machine, the rings are taken to the grinding department which is in charge of Mr. C. A. Smith, and placed one at a time on the magnetic chuck of a Heald grinder, and the sides are ground. They are next split with a milling saw and are then ready for the finishing of the outside, which is done by filling the cast-iron sleeve,

* For additional information on this subject, see "Machines and Tools for Automobile Manufacture," June, 1909, and articles there referred to.

† Associate Editor of MACHINERY.

shown in Fig. 2, with the split rings, placing it over the mandrel, putting on the loose flange and screwing on the nut. The sleeve is then removed, the mandrel placed on centers and the outside of the rings ground. The rings are now ready for the final inspection from which they are passed to the assembling department.

All of the operations on piston rings which have been just described, as well as the following ones on pistons, except the grinding operations, are done in what is known as the screw and turret department, in charge of W. F. Hittle.

The Piston Processes

The first machining operation done on a piston, is to place it in a four-jawed lathe chuck as in Fig. 3, with the open end outward, and true it up by the cored hole. The outer end is then faced off, the inside edge broken or beveled slightly with the same tool and the inside bored out to the wrist-pin bosses by the boring head shown in the tail spindle. The casting is next placed in the drilling jig, Fig. 4, and the wrist-pin hole is drilled. The work is located in the jig by means of a plug which fits the hole just made by the boring tool. Next, the piston is placed in a Gridley automatic and

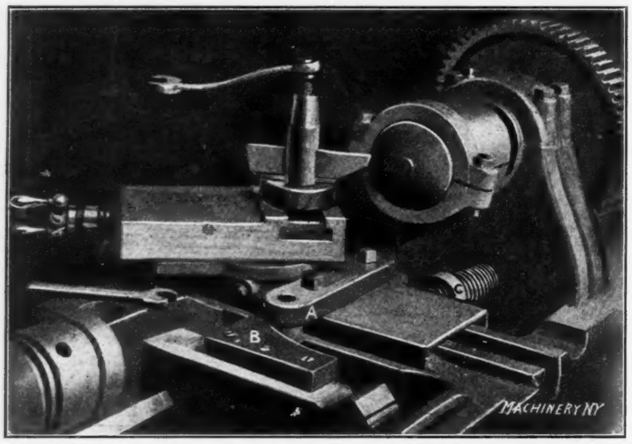


Fig. 5. Lathe equipped with Forming Slide for Turning Spherical End of Piston

the outside, the piston ring grooves, and body clearance are turned. The piston is held in the machine by means of a stub mandrel, on the nose of the spindle, to which it is fastened by a long eye-bolt running through the spindle and tightened by a hand-wheel at the back. A short piece of heavy iron rod is also inserted through the wrist-pin hole in the piston and the loop of the eye-bolt. The piston is steadied on the cut by a follow rest.

From the automatic, the piston is taken and placed in the hollow chuck shown in Fig. 5, and the closed end rounded. The cross-slide of this lathe is especially fitted with a bracket *A* carrying a roller which is pressed against the former *B* by the heavy spring *C*. On being taken from this lathe, the piston is placed in another and held in the same way as on the automatic, while the end is centered and the ring grooves

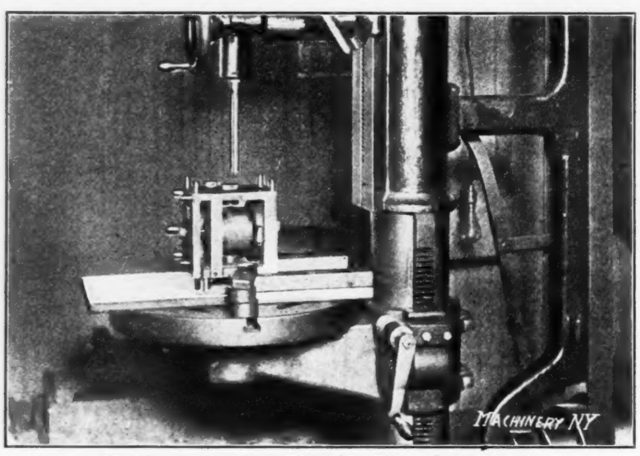


Fig. 6. Jig in which Wrist-pin Holes are Reamed

are carefully trued and sized. The piston is then placed in a Brown & Sharpe grinder, between a large and a small center and the outside ground to size; then it is inserted in the jig shown in Fig. 6 and the wrist-pin hole is reamed out. The final machining operation is to place the piston in the special machine Fig. 7, for the purpose of milling out the space between the wrist-pin bosses for the end of the connecting-rod. In this machine the work is held and located

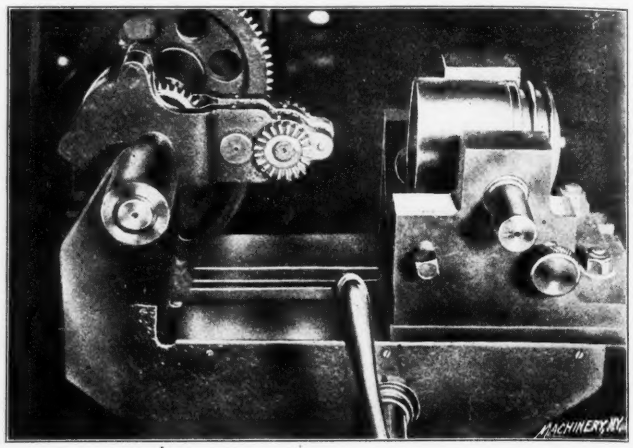


Fig. 7. Special Machine for Milling the Space between the Wrist-pin Bosses

between V-jaws with plugs inserted in each end of the reamed wrist-pin hole. The mechanism operating the mills is too plainly indicated to need further explanation. Just before the last inspection, the pistons are placed in the jig shown at *B*, Fig. 8, and the wrist-pin hole is carefully hand-reamed with a pilot reamer.

Machining Cylinders

Cylinders of the several types used on the different models of Stoddard-Dayton motors, are all machined in the machine shop which is in charge of Mr. Walter Sigler. These cylinders are of two general types: One having the water jacket cast in one piece around the cylinder with no openings other than the pipe openings, while the other type has a large opening fitted with a removable cover, both types being cast in units of two cylinders each, so made that they may be easily

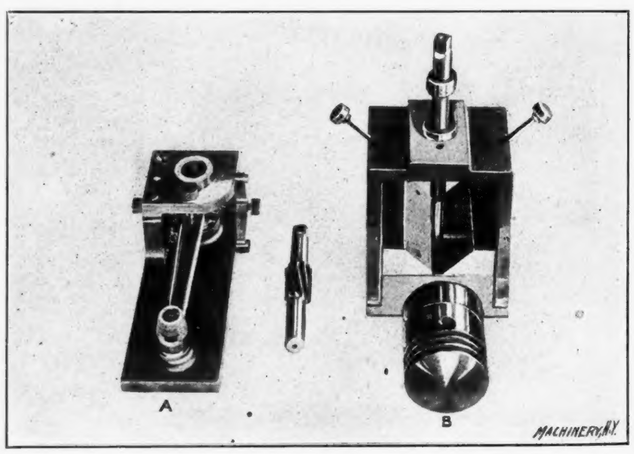


Fig. 8. Reaming Jigs for the Crank End of the Connecting-rod, and the Wrist-pin Hole in the Piston

grouped in multiples. The first machining operation on the first-mentioned type, consists in boring out the cylinders on a regular Beaman & Smith cylinder boring machine Fig. 9. This machine is arranged to hold four two-cylinder units at a time; two of the units being in position for boring while the other two are being set into the fixture. After one set has been bored, the fixture is reversed and in this way no time is lost in setting up the work. The second operation consists of drilling and reaming the valve holes in a turret-head drill press Fig. 10, the cylinder unit being held in a jig as shown. In the third operation, the water-pipe holes are drilled and tapped, and then the cylinders are strapped onto an angle-plate and the spots for the exhaust pipe flanges are surfaced off in a vertical mill. They now pass through several minor drilling operations before they are ground and given their final inspection.

The second mentioned type of cylinders, having the water-jacket covers on the sides, are bored out on the Beaman & Smith machine in the same way as the first type. The cover seats are then surfaced off in a mill and the cover holes

drilled and tapped using the jig shown in Fig. 11. The work is next placed in the indexing or tilting jig, Fig. 12, and the valve holes drilled, bored and reamed. In all, ten holes are finished in this jig. Instead of using an angle-plate to hold these cylinders while surfacing the exhaust pipe flange spots, as in the first instance, they are placed in a special fixture shown in Fig. 14.

leather padded covers being clamped over the two large ones, then filling the jacket with water, attaching a pressure gage, connecting to an air hose and running the pressure slowly up to seventy pounds, all the time watching for any indication of a leak from a crack or a flaw. A similar preliminary test is also made in the machine shop on all cylinder water-jackets before machining and after boring out the cylinders.

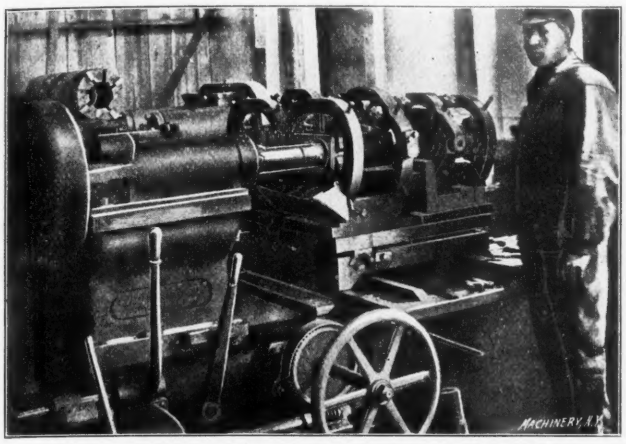


Fig. 9. Boring out Cylinders on a Beaman & Smith Machine

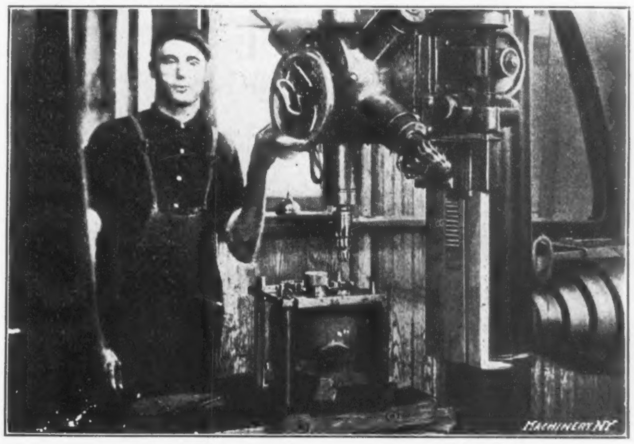


Fig. 10. Drilling, Reaming and Seating Valve Holes

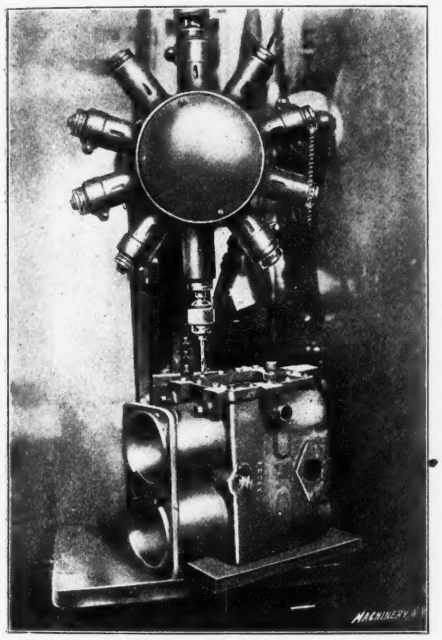


Fig. 11. Drilling and Tapping Holes for Water Jacket Cover

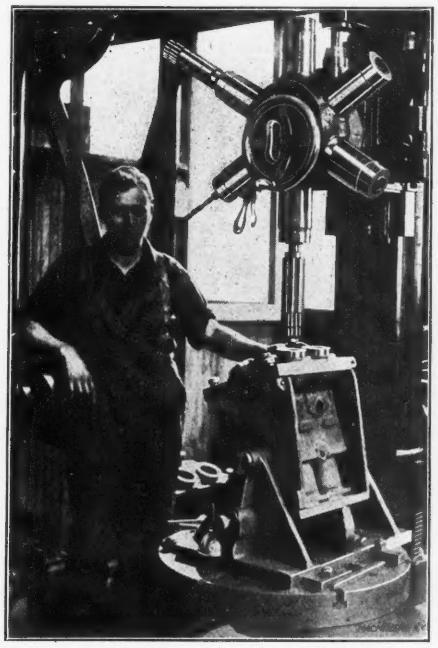


Fig. 12. Tilting Jig for Holding Cylinder while Drilling and Reaming Valve Holes

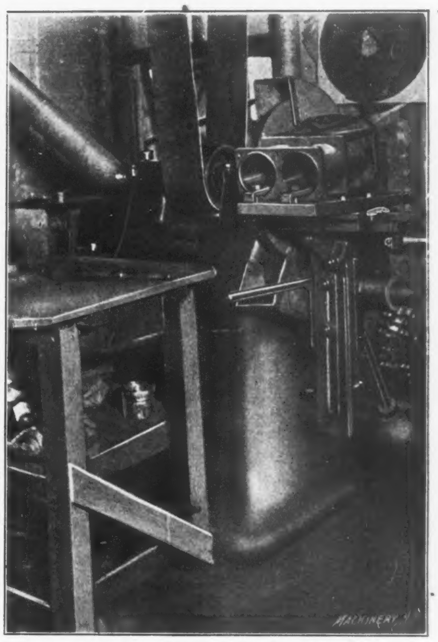


Fig. 13. Finishing Seats for Water Jacket Cover on a Besly Disk Grinder

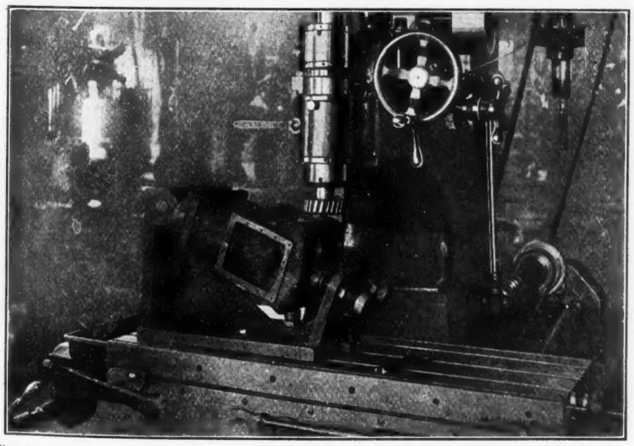


Fig. 14. Fixture for Holding Cylinder while facing Exhaust Pipe Flange Bosses

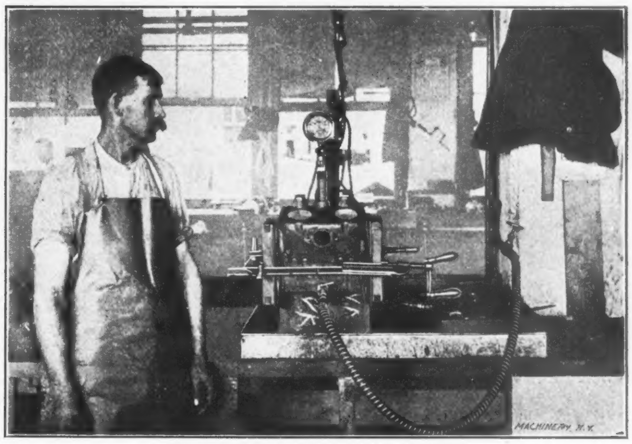


Fig. 15. Testing the Water Jackets

After all the machining operations are finished, these cylinders are sent to the grinding room and the water-jacket cover-seats finished smooth and true on a Besly disk-grinder, as shown in Fig. 13. The cylinder bores are ground on a Heald grinder.

Before being assembled in the motor, the cylinder water-jackets are tested under seventy pounds water pressure, as shown in Fig. 15. This is done by stopping up all openings,

After the connecting-rods are drilled and reamed in a box jig, the final reaming is done in the motor part assembling department, the jig shown at *A*, Fig. 8, being used for this purpose.

Cover-seats on the differential cases, are surfaced off on a Becker-Brainard vertical milling machine as shown in Fig. 16, only the cross and table feeds being used to mill the almost circular rim of the cover seat.

Push-rod fork-ends are milled with a gang mill, eight at a time, on a Le Blond milling machine as in Fig. 17, the clamps of the jig being arranged so that the tightening of one nut clamps two rods as shown.

Milling Drive-gear Clutch Teeth

In Fig. 19 is shown the way the three clutch-teeth are milled in the gear-clutch end of the drive-gear sleeve, using a three-spaced indexing jig. Fig. 20 shows the same sleeve reversed for milling the teeth in the drive-shaft end, while Fig. 21 shows the way the clearance is milled on the teeth. A wedge is inserted under the bottom of the fixture so as to give it the proper angle, and a wider mill is used. It will be noted that clearance is shown on the teeth in all three engravings. This is because a finished sleeve was used while taking the pictures, no partly finished ones being available, but of course in actual work the clearance is milled in the order given.

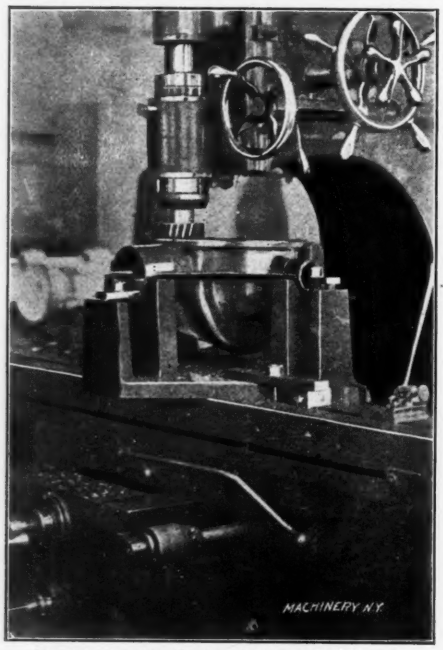


Fig. 16. Facing Seats of Differential Covers in a Vertical Milling Machine

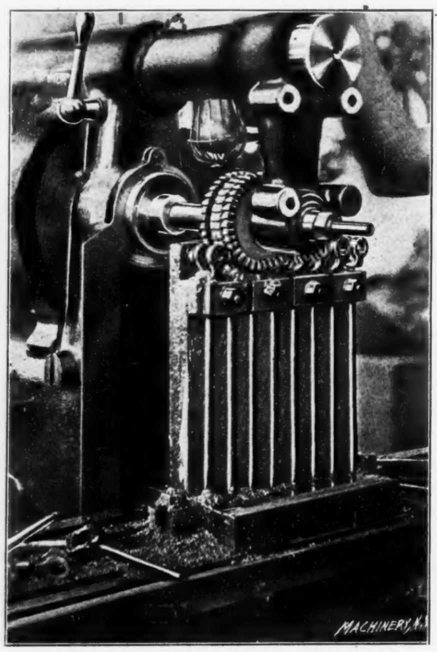


Fig. 17. Milling Eight Push-rod Fork Ends at One Time

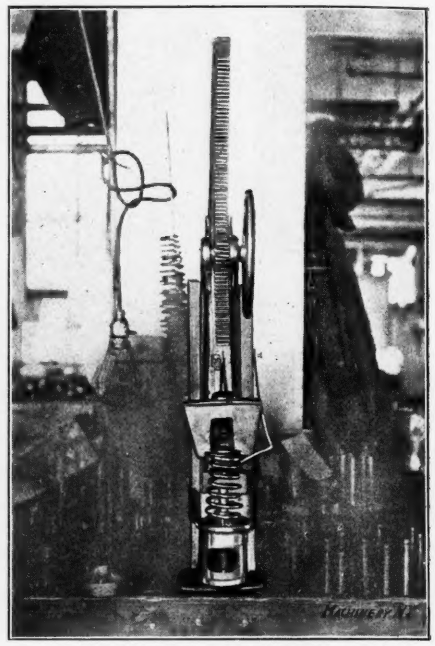


Fig. 18. Device for Compressing Valve Springs when Assembling Cages

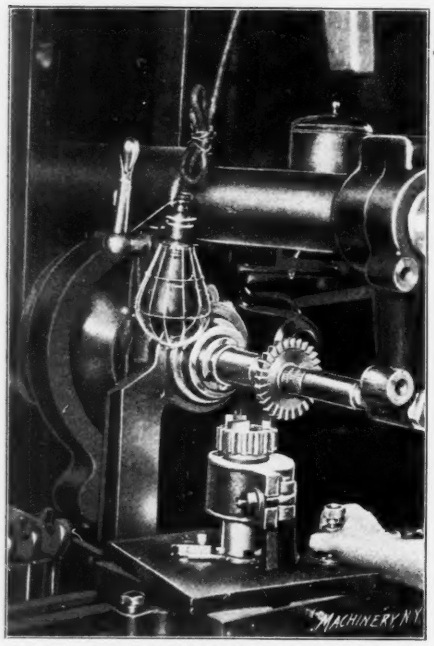


Fig. 19. Milling Clutch Teeth in Gear-clutch End of a Drive-gear Sleeve

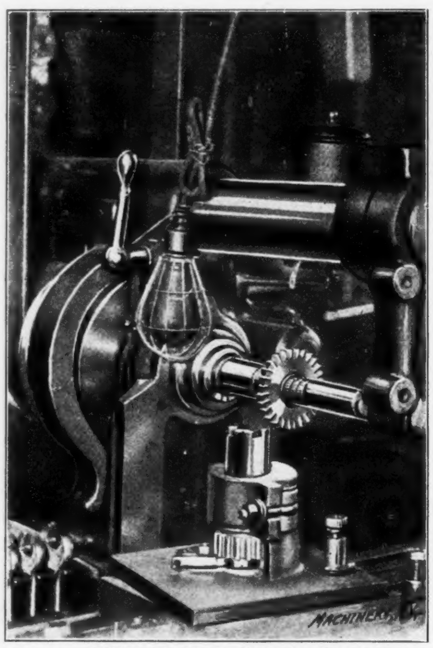


Fig. 20. Milling Clutch Teeth in the Drive-shaft End of the Sleeve

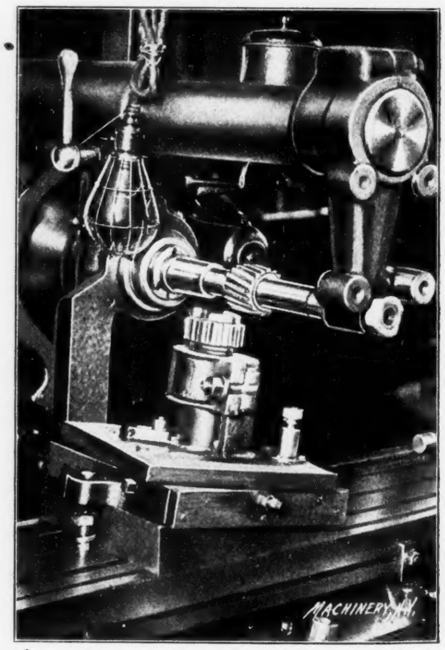


Fig. 21. Milling the Clearance on the Clutch Teeth of a Drive-gear Sleeve

Small valve cams are milled on a Garvin milling machine fitted with a Brown & Sharpe cam attachment (Fig. 22); they are then ground on a special grinder. On the new models, however, the cams and shaft are forged in one solid piece and are to be ground on a new, special grinder, now almost completed.

Crank-shaft bearings are bored out and then hand reamed in the reaming jig shown in Fig. 23; they are then broached out on a La Pointe broaching machine, the broach and guides shown lying on top of the crank-case in Fig. 24 being used. This unusual way of finishing the bearings, saves hand scraping and does a better job in far less time.

In the motor parts assembly department, in charge of Mr. L. C. Miller, there are a number of interesting things devised to expedite assembling; one of them, shown in Fig. 18, is an old paint-press made over to compress the valve springs so that the retaining washer and cotter-pin can be easily placed on the end of the valve stem, when assembling the valve-cage parts. The engraving shows a lower valve-cage and parts in position in the press ready for the compression of the spring and the placing of the washer and cotter-pin.

Crankshafts are held as shown in Fig. 25, while fitting the connecting-rods, which is much better than the usual method of holding them in a vise.

The adjustable motor assembling stands Fig. 26, are as convenient as any I have seen in use anywhere. As the engraving shows, the bed of the motor is bolted to the stand top which may be placed in a horizontal, 45-degree or vertical position on either side, as desired.

The forging department or steel shop as it is called, in charge of Mr. F. E. Sellars, is one of the most complete of any similar department of an automobile factory in the country. It is fitted with big steam hammers, board drops, forging machines, punch presses, bulldozers, special benders and

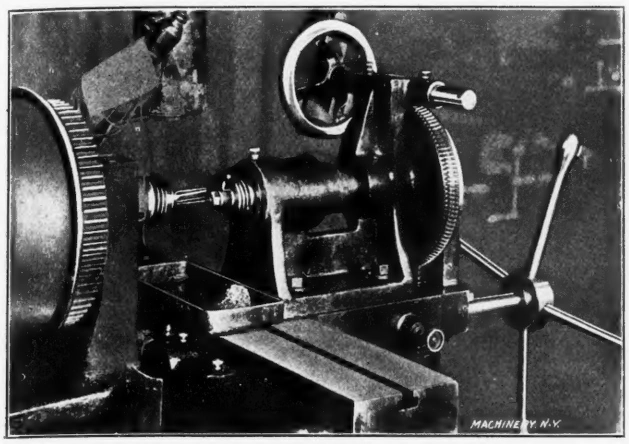


Fig. 22. Milling Small Cams on a Machine equipped with Brown & Sharpe Cam Attachment

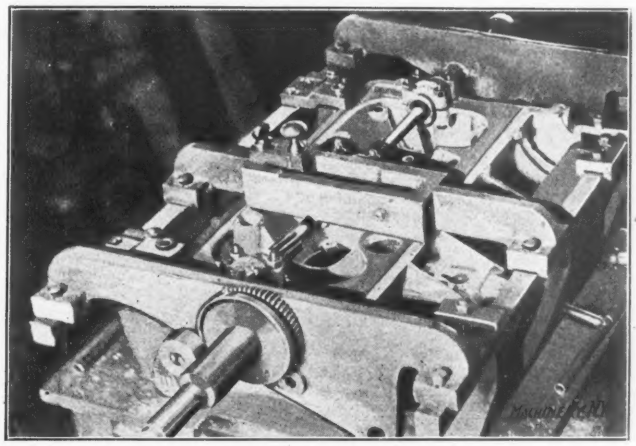


Fig. 23. Reaming Jig for Hand Reaming Crank-shaft Bearings after the Boring Operation

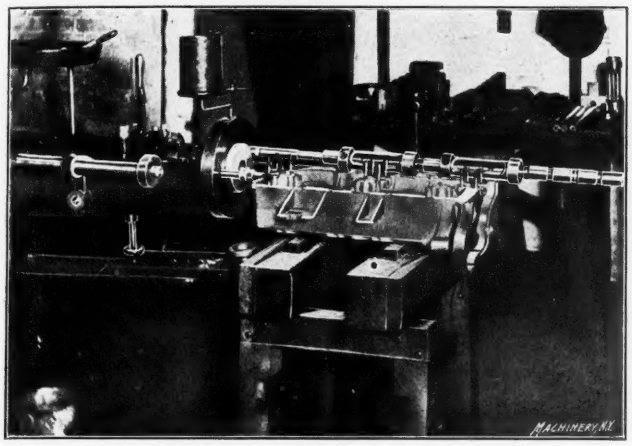


Fig. 24. Special Broach for Broaching Crank-shaft Bearings after they are Reamed

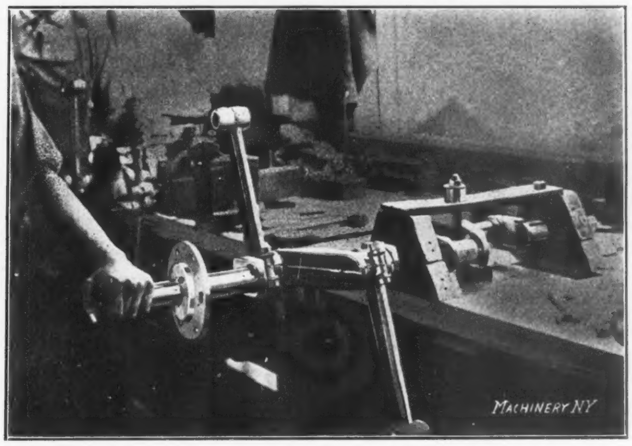


Fig. 25. Bench Clamps for Holding Cranks while Fitting the Connecting-rods

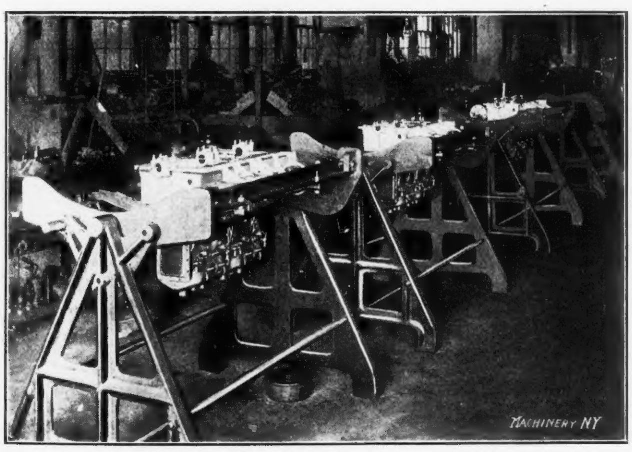


Fig 26. Adjustable Stands for Motor Assembling

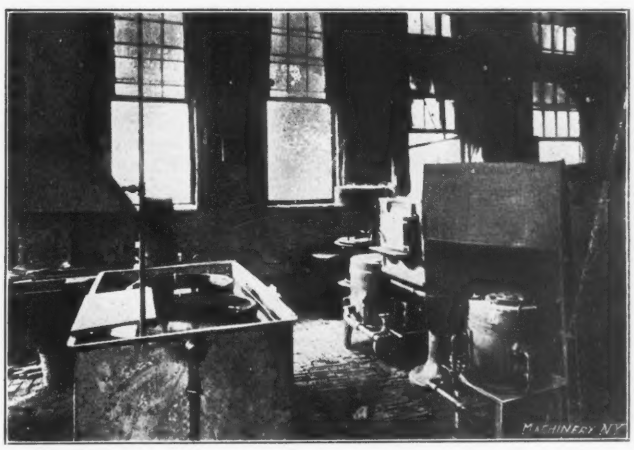


Fig. 27. Barium-chloride Hardening Furnaces and Cooling Tanks

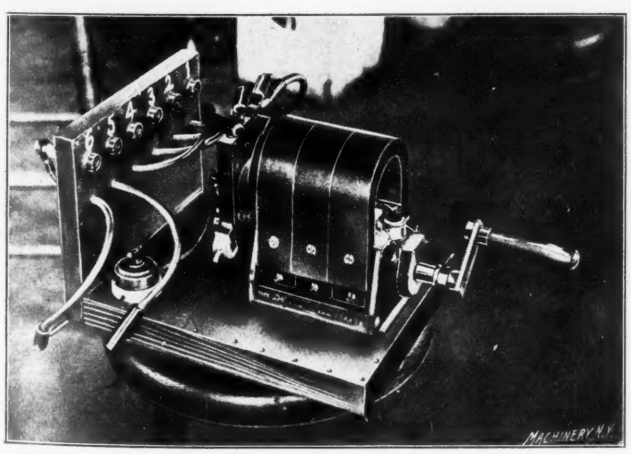


Fig. 28. Apparatus for Testing Magnetos

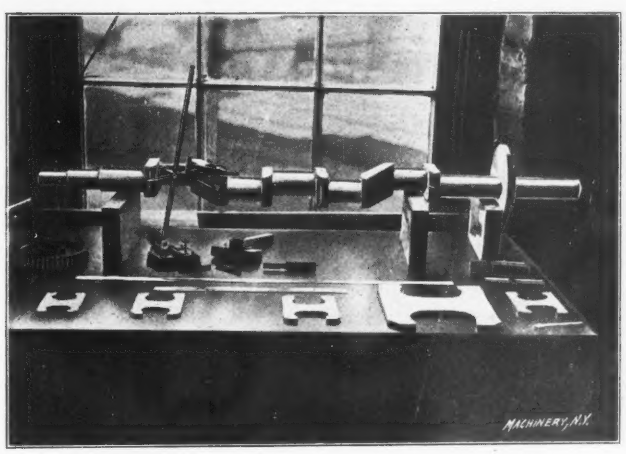


Fig. 29. Various Gages used for Testing Crank-shafts

heating furnaces, and everything that is used that is a forging, as was previously stated, except crankshafts, is made here. Even the long, channeled frame-slides are formed out of the heavy steel bands in which form they come from the steel mills, and the holes in them are punched, using a big templet as a guide instead of laying out the holes and drilling as fre-

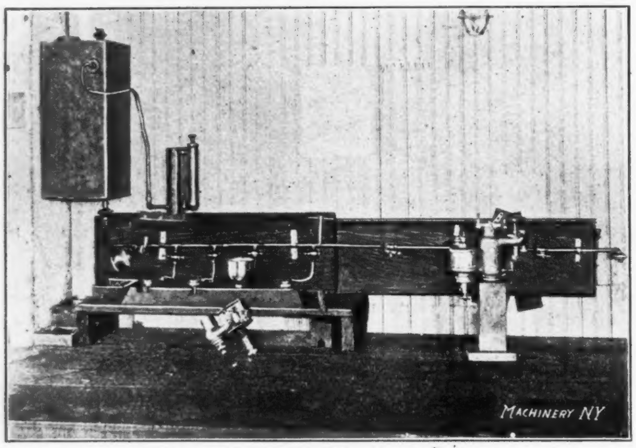


Fig. 30. Apparatus for Testing Carbureters

quently is the case. This department also contains the most complete barium-chloride tool-hardening plant in the West, with the possible exception of that of the Firth-Sterling Steel Co., in Chicago. A partial view of this department, showing the oil heated crucible furnaces used for melting the barium chloride, is shown in Fig. 27.

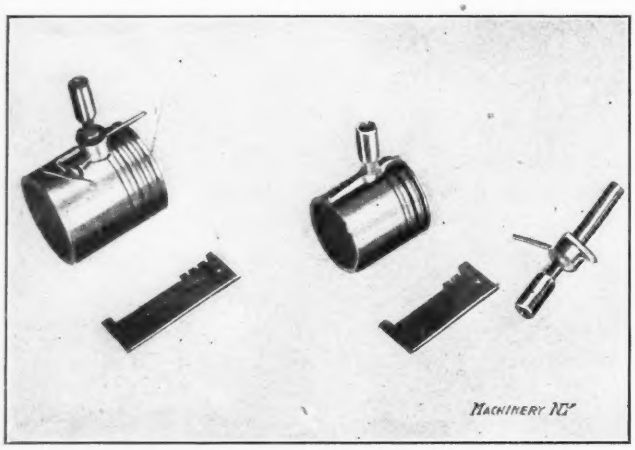


Fig. 32. Piston Gages

The motor testing department, in charge of Mr. George Gorton, is also very complete, being fitted with all the necessary testing apparatus and a French manograph. As in all factories doing high class work, the testing and inspecting departments are the ones on which the reputation of the product depends, for no matter how good the design is, if

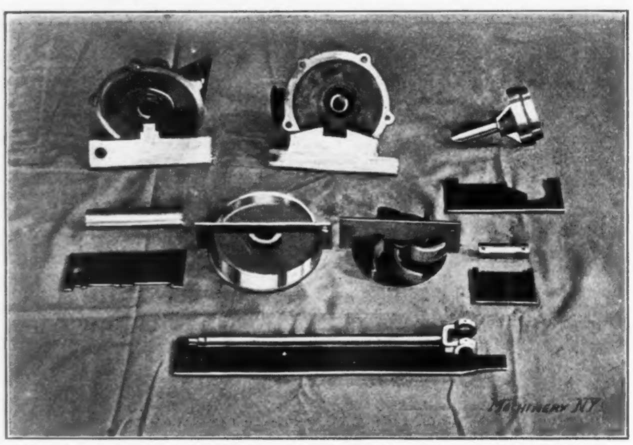


Fig. 34. Some of the Parts which are tested by the Templet Gages

the testing or inspecting is not thorough, the good designing soon is lost sight of by dissatisfied users. Recognizing this, the most rigid inspection is given all parts between each operation and before they are used or sent out. Of all the inspecting departments, that of the motor parts inspection in charge of Mr. M. Manny will probably be of the most interest to readers of MACHINERY. In this department, purchased parts are given an especially careful test as to material, workmanship and efficiency. Magnetos and their timers are carefully tested as shown in Fig. 28. This apparatus consists principally of a board with spark-plugs numbered to corre-

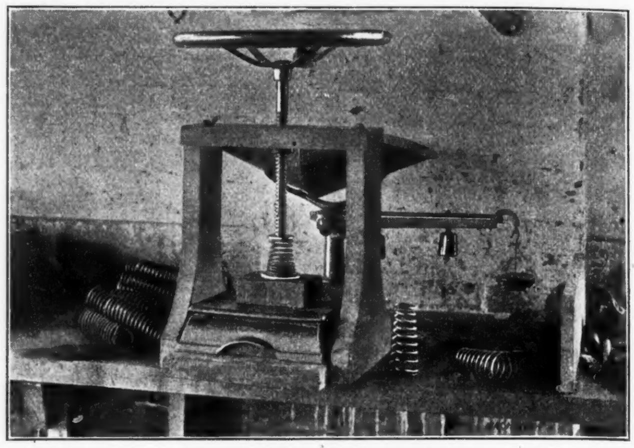


Fig. 31. Spring Testing Device

spond to the number of cylinders to be operated. These plugs are joined to the timer by suitable connections and a crank is fastened to the spindle of the magneto, so that by turning this crank and watching the resulting sparks, the tester can easily see if the spark-plugs respond in the correct order and with a spark of the proper "fatness."

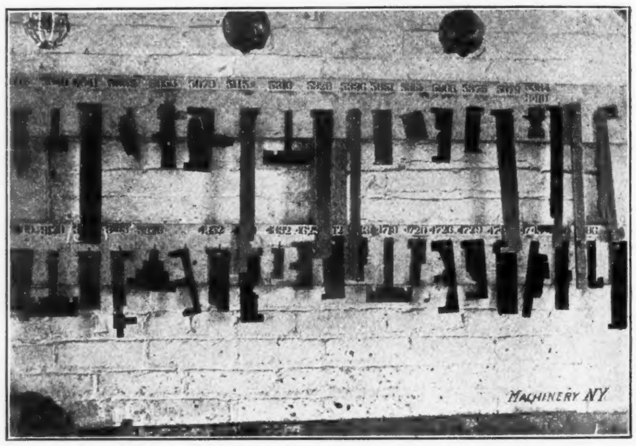


Fig. 33. Group of Miscellaneous Templet Gages

Crankshafts are tested on the large surface-plate shown in Fig. 29, the parallels, limit gages, indicators, scales and parts shown being used.

Carbureters are tested for leakage as shown in Fig. 30, a gasoline tank and pump to give the proper pressure together with a pressure gage and suitable fittings making up the

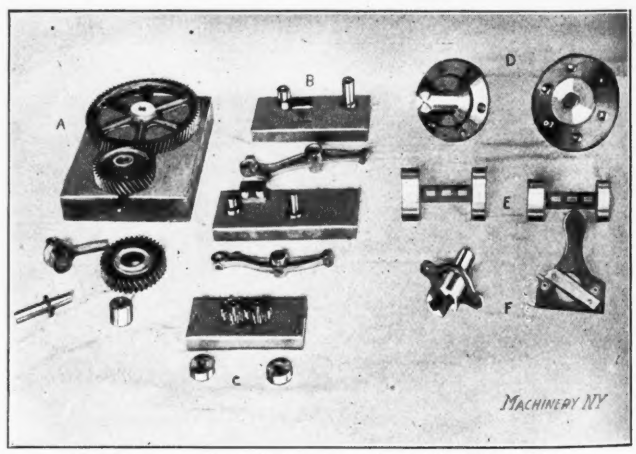


Fig. 35. A Number of Gages used in Testing Motor Parts

apparatus. Schebler carbureters are tested at ¾ pound pressure, and Stromberg's at 2 pounds.

Valve and push-rod springs, are tested as shown in Fig. 31. These springs are tested according to certain tabulated data. For instance, the spring shown must give a pressure of 60

pounds when compressed to $2\frac{1}{8}$ inches, a slight variation being, of course, allowable.

Pistons are measured for diameter, and the angularity and size of the wrist-pin hole, the length of the piston, the depth, spacing and size of the grooves are tested with the gages and templets shown in Fig. 32.

A group of flat metal templets, used for various purposes is shown in Fig. 33, and the way some of them are used for testing pump and other parts is shown in Fig. 34.

At *A*, Fig. 35, is a device for testing the center distance and proper meshing of the timing gears, the small gear being mounted on an eccentric pin with a small lever attached, and the center distance being obtained by calipering the centers when the gears are properly meshed. At *B* are two rocker-arm contact gages; *C* is for testing small pump gears, the disks being used to test the accuracy of the pins from time to time; at *D* are two flywheel bore and drilled hole gages; at *E* are two Brown & Sharpe limit plug-gages and at *F* is a valve plunger guide and gage.

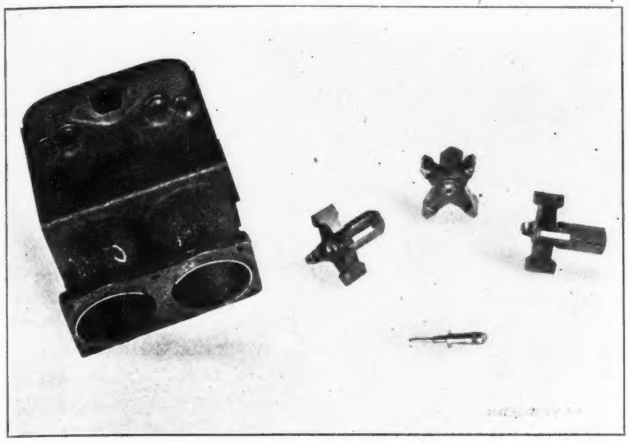


Fig. 36. Cylinder Bore Limit Gages

Fig. 36 shows a cylinder and three bore gages. The middle one is standard, the one at the left is 0.002 inch small, and the one at the right is 0.002 inch large, while in case of doubt the inside micrometer is used.

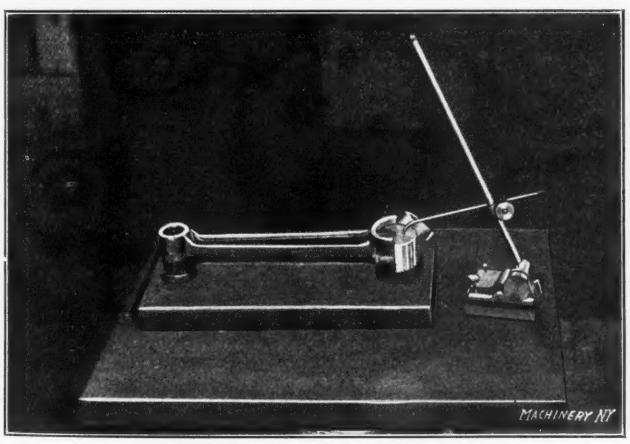


Fig. 37. Method of Testing Connecting-rods

Connecting-rods are tested as in Fig. 37, the pins in the plate being exactly the proper distance apart and of the correct diameter. The surface gage is used to test the amount of offset at the large or crank end.

In preparing this brief description of a few of the interesting things to be found at the Dayton Motor Car Co.'s plant I am especially indebted to Mr. Harry Tuttle, Chief Engineer Edwards, Supt. Houk, and also to Mr. A. C. Miller, the well-known racing man, who acted as guide.

* * *

According to the *London Financial Times* a new patent law was enacted in Austria last December which came into force in June this year. This law contains a section similar to that of the new British patents act by which patents in Austria will be revocable at the expiration three years from the date of publication, without any notice, if the patent is not worked in Austria to an adequate extent.

FACE-PLATE FOR ECCENTRIC PISTON RINGS

CONTRIBUTOR

The design of a special plate to be secured to an ordinary face-plate for holding any work to be either bored or turned eccentric, is shown in Fig. 1. When turning eccentric piston rings, for example, any degree of eccentricity can be obtained from zero to the maximum amount that the plate is designed to give, and, in addition, all the operations such as boring, turning and cutting off the rings can be performed at one setting of the casting.

The construction of the plate is clearly shown in Fig. 1. The outer part *C*, to which the work is attached, is secured to a plate *D* by the bolts *E* and *F*. The bolt *F* acts as a fulcrum for the plate *C*, which swings upon it to either of the extreme positions of eccentricity indicated by the dotted lines *B*. The hole in the part *D*, for the bolt *E*, is elongated as shown in the elevation so that the bolt is free to move when the plate is being set over for eccentric turning or boring. The spring *H* serves to keep the faces of the two plates in contact when the nuts are slacked off to permit the plate *C* to be moved. This prevents the possibility of any dirt getting between the plates. Assuming that it is first necessary to turn a piece of work, the casting would be set true by the outside, with the locating plate *C* in its central position *A*, in which it runs true with the face-plate proper. After the turning operation, the two nuts on bolts *E* and *F* would be slacked off slightly, and the locating plate pushed over the required amount. The nuts would then be tightened and the inside bored to the size required; the outside, of course, would be running eccentric. By graduating the plate as shown at *G*, it can be quickly set to any desired amount of eccentricity.

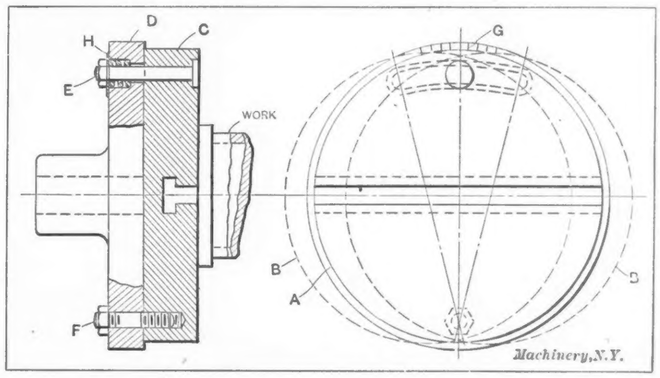


Fig. 1. Special Lathe Face-plate for Turning Eccentric Rings, etc.

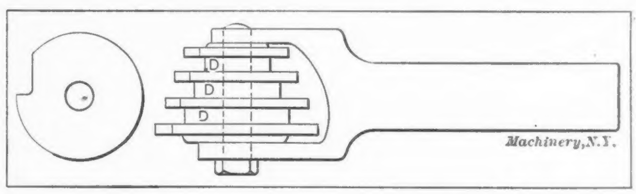


Fig. 2. Cutting-off Tool for Piston Rings

The tool-holder shown in Fig. 2, which is equipped with circular cutters, may be used to part the rings to the correct width. As will be seen in the illustration, the distance pieces *D* determine the width of the rings. These distance pieces should be made of mild steel as it affords a better surface grip than if hardened steel were used. The shape of the cutters is shown by the outline to the left of the engraving.

* * *

The number of automobiles in use in Germany slightly exceeds 20,000. The number in use in the United States has been estimated to be 160,000, or twice the number of the automobiles in use in the whole of Europe. There are 69,000 automobiles registered in New York state alone. In a statement recently published by the American Motor Car Manufacturing Association, the number of concerns building automobiles in the United States is given as 253, and the capital invested in the automobile industry, including that of kindred trades, sales-rooms, garages, etc., is nearly $200,000,000.

SUGGESTIONS FOR A MODEL BLACKSMITH SHOP*

JAMES CRAN†

Buildings for manufacturing purposes are as a rule constructed more or less in accordance with recognized standards that have been adopted on account of their adaptability for the particular class of work they are to be used for. In plants of the larger machine-building concerns and similar industries usually all buildings are of the same general style throughout with the exception of the blacksmith or forge shop, which is often entirely different. Why this should be, no good reason is apparent from a practical point of view, as the style adopted is often less suitable for the purpose than that of the other buildings, and the result is that very often blacksmiths and forge men have of necessity to work under conditions that are anything but an incentive to the best results. Workmen, no matter what the nature of their occupation may be, will do more and better work under pleasant and attractive conditions than they can be expected to do in a gloomy atmosphere. In this respect blacksmiths are no exception to the rule. As their art is indispensable to all other industries, a few practical suggestions that would have a tendency, if adopted, to reduce cost, increase and improve production for the employer, and bring about better conditions for the blacksmith, may not be out of place.

The principal essentials of a blacksmith shop where maximum production at minimum cost is expected are light, ventilation, sanitary arrangements and sufficient space to accommodate a full equipment of machinery and appliances systematically arranged and installed. What the writer considers a basis that could be worked from in constructing, equipping and arranging blacksmith shops from a few forges capacity to the largest is shown and described in the following:

Foundations and Walls

To begin with, the foundation has first to be considered. Where a rock bottom can be had very little preparation for building is necessary, but where building has to be done upon sand, clay or swampy ground it is important that the foundation be made thoroughly solid, otherwise the jar from steam hammers and other machinery will have a tendency to warp and crack the walls. The construction, in general, like buildings used for other purposes, should be governed to a certain extent by the class, size and weight of the work that has to be done. If used for light forging exclusively, the walls need neither be as high nor as heavy as where the work is varied or of large proportions. For light and medium weight work walls need not be more than from 15 to 20 feet in height, but for heavy work or where it is of a wide variety as in railroad or heavy machine building shops the walls should be from 20 to 25 feet in height so that there would be sufficient space between the tops of large steam hammers and the roof trusses for the free use of jib cranes or other overhead lifting and conveying devices.

Very little can be said regarding the foundation specifically, as general conditions and the nature of the site would have to be taken into account before any authentic information could be given, other than that it should be made as solid as possible. The walls, preferably of brick or reinforced concrete, should be of a more substantial nature than is generally required for other purposes. The piers between windows may be supported either with pilasters or buttresses or a combination of both. For the admission of plenty of fresh air which is essential in all manufacturing buildings, especially in blacksmith shops where more or less heat is radiated from forges and furnaces, the windows should not be over 36 inches above the level of the floor. If placed higher in the walls, which is often done to save their being broken by flying pieces of iron or steel, or to conform with a pet theory of protecting the men employed from drafts, they are too high to be of much benefit other than admitting light, as the greater portion of the air admitted enters at a point too high to benefit the workman or to keep the lower portion of the shop where heat is generated cool enough to be comfortable. Plain sash windows that can be raised from the bottom and lowered from the top are the best type to use and can be protected inside and out with wire screen. In locating doors it is well to have one in each end of the building large enough for the admittance or removal of any kind of work or material and to have others in the side walls where they may be required.

Forge Space and Arrangement

The next thing that calls for attention is the amount of space that is necessary for each forge. This depends very much upon their arrangement. If they are grouped as is customary in some shops, a saving of space is effected, but work in general cannot be so conveniently or economically handled as when they are arranged in rows, for the reason that in groups men from some of the forges will either have to pass between other men and their forges or anvils or take a long roundabout way to and from steam hammers; not only this, but work is often of a shape that can only be handled to advantage on forges with at least three sides accessible. It is therefore advisable that they be arranged in rows sufficient distance from the walls to allow of portable vise benches, surface plates, etc., being used where the light is best and moved from place to place as they are required without necessarily taking them into the center of the floor or between blacksmiths and steam hammers. With forges installed from 5 to 6 feet from the walls and 16 feet of space allowed for each as shown in Fig. 1 there would just be sufficient space around them for the tools generally used at the anvil and the convenient handling of all ordinary blacksmith work. For light work they may be placed a little closer than 16 feet, but more difficulty is experienced in trying to do work in limited space than where there is sufficient room. Wherever conditions will permit it is preferable to have blacksmith shops, if they exceed the capacity of 10 forges, wide enough for a row on each side with corresponding rows of steam and power hammers facing the forges on the side of the shop in which they are installed.

Forges used for the average range of blacksmithing are from 36 to 48 inches in width. With these placed 5 feet from the walls and anvils from 18 to 24 inches out from the line of forges the distance from wall to anvil will be approximately 11 feet. At least 12 feet of clear space should be allowed between the line of anvils and steam or belt-driven hammers, the bases of which are anywhere from 5½ to 8 feet in length. As a certain amount of space behind the hammers is necessary, 10 feet more may be added. Thus a shop of approximately 40 feet in width is required for single rows of forges and hammers and 80 feet for double rows. The advantages of a short wide shop over a long narrow one are obvious. It is more compact and better under the observation of the man in charge. The space back of the steam hammers is doubled, making the center of the shop wide enough for a line of car tracks which may be standard or narrow gage, and the handling of work too long or of a shape that could not be advantageously handled by ordinary means. Not only this, but the saving in actual construction, which would amount to about one-third, is an item too important to be overlooked.

There are, however, certain elements to be contended with in the construction of a wide building that can be entirely dispensed with in a narrow one. When a building exceeds a certain width some supports for the roof other than the walls are necessary if cost, which is a prime factor, is to be kept at the lowest margin. These roof supports are generally in the form of columns so arranged that the weight is evenly divided. In blacksmith shops columns or supports should be located where they would offer the least obstruction to the handling of work which is almost invariably hot, and the success of the various operations of shaping it depends upon reaching a steam hammer in the least possible time after it is removed from the fire. It is therefore obvious that the fewer obstructions there are to be avoided the greater the probability of the work being successfully accomplished. Just behind the line of steam hammers, columns would be entirely out of the way and would serve the double purpose of supporting the roof and traveling cranes or trolleys.

* For data previously published on this subject, see MACHINERY, February, 1904, "Machine Shop Equipment—Equipment of the Forge Shop."

† Address: 916 West Third St., Plainfield, N. J.

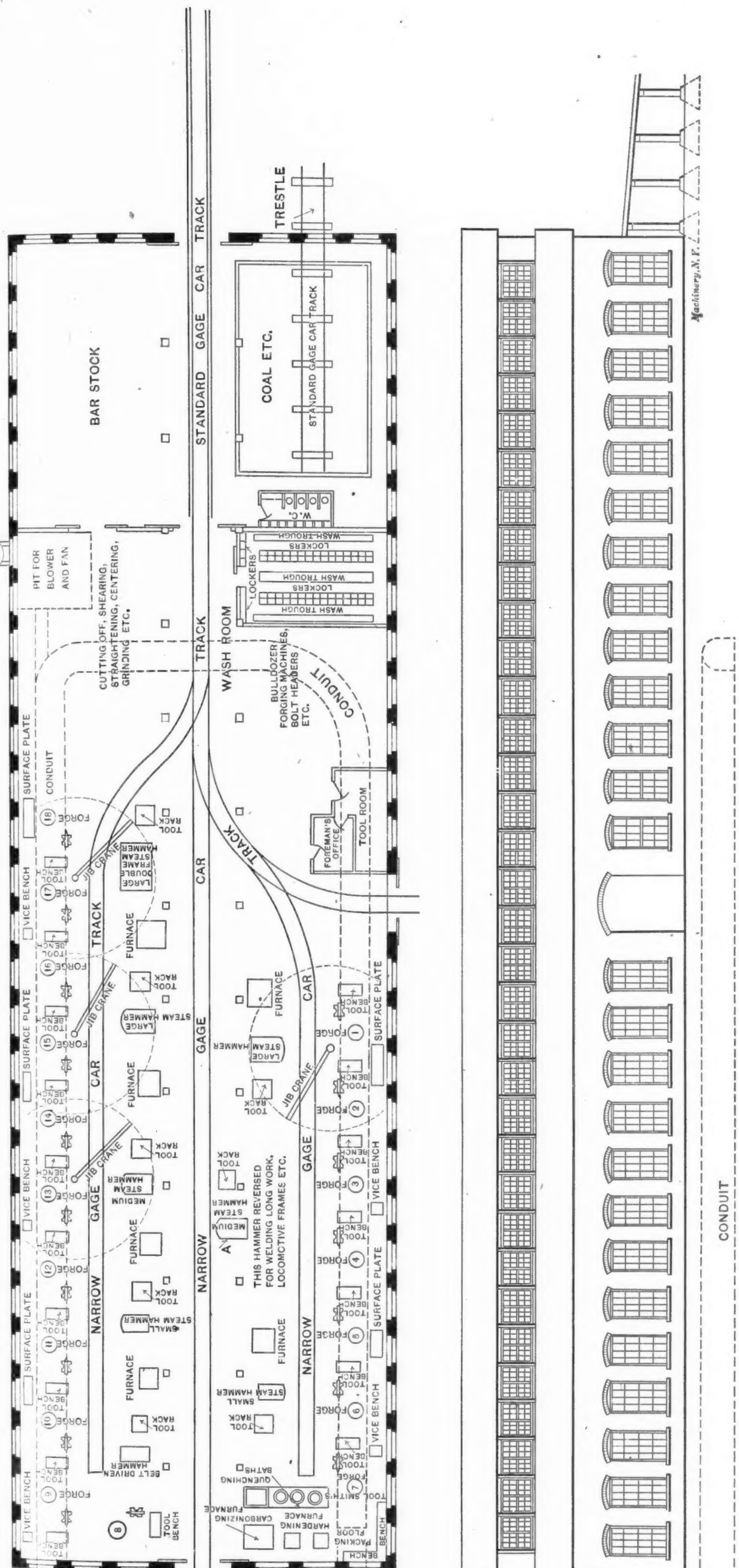


Fig. 1. General Layout and Side Elevation of Blacksmith Shop

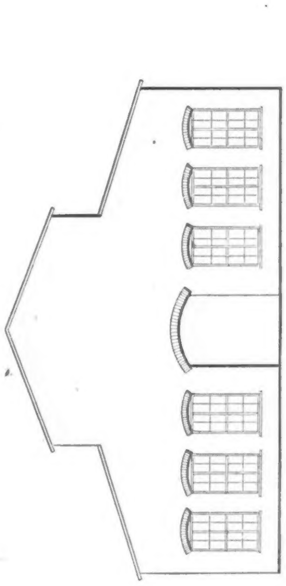


Fig. 2. End View of Blacksmith Shop

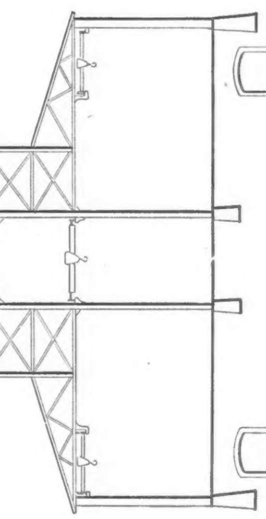


Fig. 3. Cross-section, showing Travelers

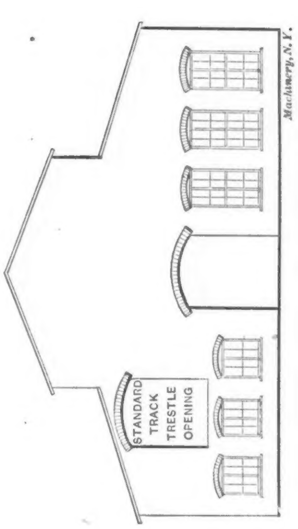


Fig. 4. End View, showing Car Trestle Opening for Discharging Fuel

These points considered and provision made for the storing of bar stock, coal and other materials used in blacksmithing in the same building or adjacent to it constitute the most important features of an ideal blacksmith shop, which may be constructed, laid out and arranged as follows, or the general idea used as a basis to work from.

The general arrangements of a shop of 18 forges in which provision has been made for a full equipment of appliances generally used in a shop of that capacity are shown in Fig. 1. One end is assigned to material, as bar stock, coal, etc., and space for cutting off and centering machines, in short all that is required for putting work in proper condition to be turned over to the machine shop without workmen having of necessity to go outside the building. Forges are arranged in rows 5 feet from the side walls, with those intended for the largest and heaviest work nearest to the stock supply for which one end of the building is exclusively assigned. All forges are served by an overhead trolley system, one cross section of which is assigned to each forge for lifting and supporting work at the anvil. Forges for the larger work are further supplied with jib cranes so arranged that the column is well out of the way of work so that one can be used for conveying to and supporting at the steam hammer the work of two forges, the furnace being located near the hammer that it serves.

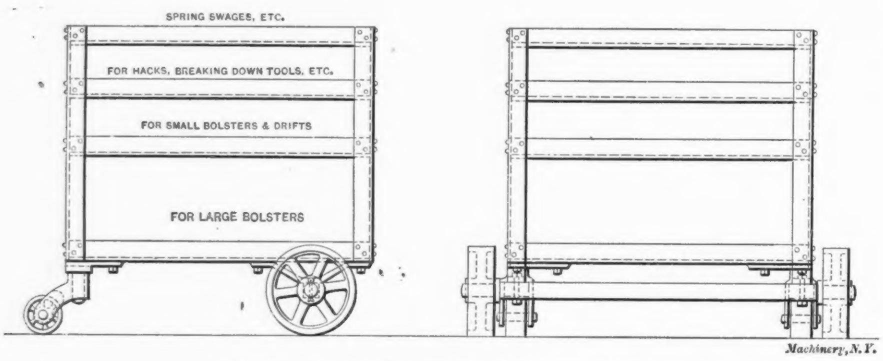


Fig. 5. Portable Rack for Steam Hammer Tools

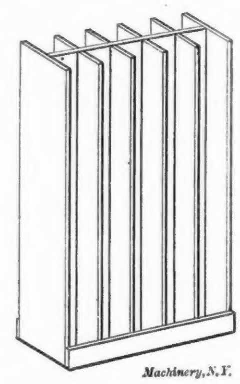


Fig. 6. Upright Rack for Light Bars

Arrangement of Steam and Belt-driven Hammers

All power hammers, steam and belt-driven, with the exception of one, which will be referred to later, are installed in rows facing the forges at a distance of 12 feet from the line of anvils, which is just sufficient space for the general range of blacksmith work being done at steam hammers without conflicting with that being done at forges. The steam hammer *A* which is reversed and out of alignment with other hammers can be used for such work as welding long shafts, leadscrews for long lathes, locomotive frames or any other work too long or of a shape that could not be advantageously handled by ordinary means. This class of work is supported by hooks from an overhead trolley and heated in a portable forge so arranged that it drops clear of the work when it is ready to be conveyed to the hammer by turning a lever. This forge was shown and described in MACHINERY, December, 1908, in connection with an article on welding. No definite information can be given upon the number of steam or power hammers necessary for any given number of forges, as that would depend very much upon the class of work to be done. Sometimes three or more blacksmiths could use the same hammer to block out their work without wasting time in waiting for turns or one man's work conflicting with another's, while on other kinds of work one man may monopolize one hammer for a time. In any case the equipment of hammers and other power appliances should be ample for the requirements, otherwise much time may be wasted in men having to wait after their stock is heated before they can have access to a hammer or in having to leave it before an operation is completed. In a shop of 18 forges where work is of a wide variety of shape and size, from 6 to 9 hammers will be required. Generally a great part of machine blacksmithing, especially blocking out, can be much more economically heated in furnaces than is possible when forges are used exclusively. It is therefore advisable to use furnaces for all work that can be heated in them and have them as near to steam hammers as is practicable. In most of the blacksmith shops connected with manufacturing plants one or more toolsmiths are employed and more or less carbonizing, heat treating, annealing, hardening and tempering has to be done. This class of work should be as much concentrated as possible, located in the shop where it would be least likely to conflict with other work and be under the charge of a sub-foreman. Saws, shears, cutting-off, straightening and centering machines, together with any other machine tool that may be used, should be located near the stock supply and if possible near the point from which finished work is forwarded to the various departments where it is wanted. These machines and all bar stock would constitute a department that could be attended to by a sub-foreman.

Location of Blowers—Conduits—Piping

The blower for supplying forges and furnaces with blast and the fan for mechanical draft, if a down-draft system of carrying off smoke and gases is to be used, may be installed as near to each other as is practicable and operated by the same mechanism, preferably motor drive. Common practice is to elevate blowers and fans above the level of forges; sometimes they are placed upon a platform in the roof trusses to save floor space. This practice is not to be commended for the reason that when the wind gate of a forge or furnace happens to be left open when the blower is closed gas generated by the still ignited fuel upon the forge enters the pipes and naturally rises. It may escape through the blower unless it happens to be started up before the fire upon the forge has died out. When this happens the gas is forced back upon the still burning fuel where it is ignited, causing an explosion which may ruin pipes and damage the blower. If blowers and fans are installed in a pit below the level of the floor they are more accessible and the danger of being damaged by explosions is minimized from the fact that gas will not descend except when forced. Generally blast is conducted from the blower to forges and furnaces through a main pipe which is reduced in size as it passes the various branch pipes which connect with the forges. This has a tendency to make the pressure greatest near the terminal

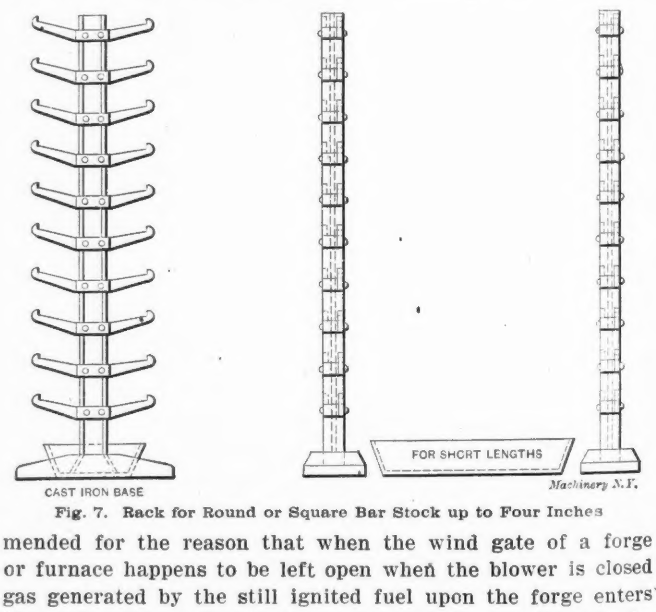


Fig. 7. Rack for Round or Square Bar Stock up to Four Inches

of the main pipe. To equalize the blast pressure at all points the main pipe should be in the shape of a loop, both sides of which may be of equal capacity to the discharge of the blower so that it would act as a reservoir permitting of branch pipes being connected with it at right angles instead of the more acute angles generally used, and should it be necessary to increase the blowing facilities or enlarge the capacity of the shop this could be done without changing the blast pipe. In an ideal blacksmith shop all piping should be where it is least likely to be in the way and still be accessible. For this purpose an underground conduit in the shape of a loop directly under the line of forges as shown by dotted lines in Fig. 1 and in cross-section in Fig. 3 of a size sufficient to accommodate the entire piping system including blast, steam, water, gas, oil, compressed air, heat for warming

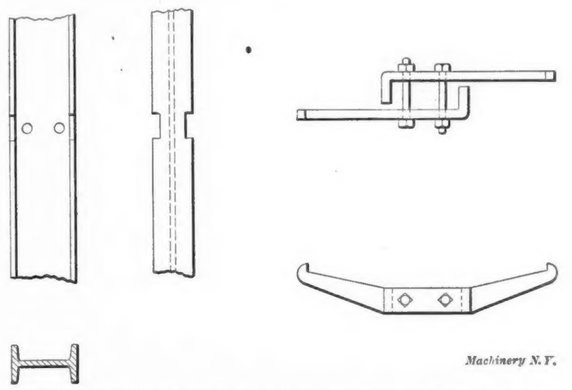


Fig. 8. Detail of Upright and Arms for Rack shown in Fig. 7

the shop in cold weather, smoke, sewer or any other piping or wiring that may be necessary and to which access may be had through openings in the floor between forges. These openings should be lined with concrete covered with slatted platforms upon which blacksmiths could stand at their work and through which heat could be admitted in cold weather and cool air in warm weather either through the heating system or openings in the walls fitted with gratings and shutters that could be opened and closed at will. The water supply which is essential in all blacksmith shops is more important than is generally supposed; each forge ought to be provided with a slake tub, the water in which should be kept fresh. If this has to be carried from a general supply pipe as is customary in most shops, much time is wasted both in emptying and refilling the tubs that could be turned to good account if a faucet and sewer connection is located near each forge and elsewhere about the shop where they may be required. These connections should not be made directly with the tubs, except at forges used by tool-smiths or where hardening has to be done, as it is often necessary to move tubs and other appliances at forges used for regular forging to make room for work of unusual shape.

Furnaces—Tool Racks—Hammer Foundations and Piping

Furnaces to be used for heating work that is to be blocked to shape in quantities at steam hammers and those used for heating material to be drop-forged or shaped in forging machines, bolt-headers or bulldozers may be heated either with solid fuel or oil. Oil is preferable for several reasons. It is conducted from the supply tank to where it is to be used automatically through pipes. Once ignited the supply can be regulated and the heat maintained at an even temperature for any length of time. There is practically no refuse to be removed and no time is wasted in waiting for a fresh supply of fuel reaching the proper temperature for the work to be done as is the case with any kind of solid fuel. For each steam and power hammer there should be a tool rack, preferably portable, of which Fig. 5 is an example, that would accommodate a full set of spring swages, fullers, breaking down tools, hacks, bolsters or any other appliances that may be used in connection with hammers, each tool as far as possible being assigned to its own place upon the rack. This would overcome the disadvantage of having to turn over a miscellaneous heap of tools usually stacked upon the floor to find the one that is wanted and to move them individually should the space they occupy be temporarily wanted for some other purpose.

To get the greatest efficiency from steam power hammers the foundations upon which they are mounted must be solid. Concrete resting upon hard pan has given better results than the combination of heavy wooden beams and concrete commonly used. In installing solid concrete foundations there should be several inches of cement placed over the concrete and a cushion of wood at least three inches in thickness placed between the cement and the base of the anvil to give the necessary resiliency and prevent the concrete being pulverized by the impact of the blows. Back and front of the hammers there should be openings down to the level of the anvil base so that it could be leveled or adjusted by wedging up and grouting with cement if for any reason it should get sagged or out of alignment with the upper parts of the hammer. These openings should be covered with hatches level with the floor.

By conducting steam to hammers from the main steam pipes in the underground conduit through branch pipes provided with traps the disadvantages and annoyance caused by condensation are practically obviated, providing the supply pipes are enclosed in non-conductive casing until they are connected with cylinders. The exhaust and all other pipes leading from hammers may be accommodated in the same casing down to the floor level, where they may be conducted outside the building through conduits and allowed to discharge in the usual manner or be turned into a condenser and ultimately into the sewer.

Foreman's Office, Wash Room, Lockers, Etc.

The foreman's office and the room used for special tools, fixtures, formers, welding compounds, etc., should be connected, if possible, and located centrally in a position from which the whole or the greater part of the shop could be easily seen and if possible near the door that is used the most. If that happened to be a side door, office and tool-room may be as shown in Fig. 1. Should an end door be more convenient the office and tool-room may occupy the space assigned to forge No. 8. For convenience as well as economy blacksmith shops should be provided with washing accommodation, locker rooms and lavatories, which would not only add to the comfort of the men employed, but would be the means of saving the time that is wasted in going to other buildings. In a shop of 18 forges there should be locker and washing accommodations for at least 60 men. This at a conservative estimate would occupy at least 650 square feet of floor space. The lavatory for obvious reasons should be separate from the locker and washroom, but in close proximity, and is therefore shown in the floor plan just beyond the partition that separates the shop from the coal storage.

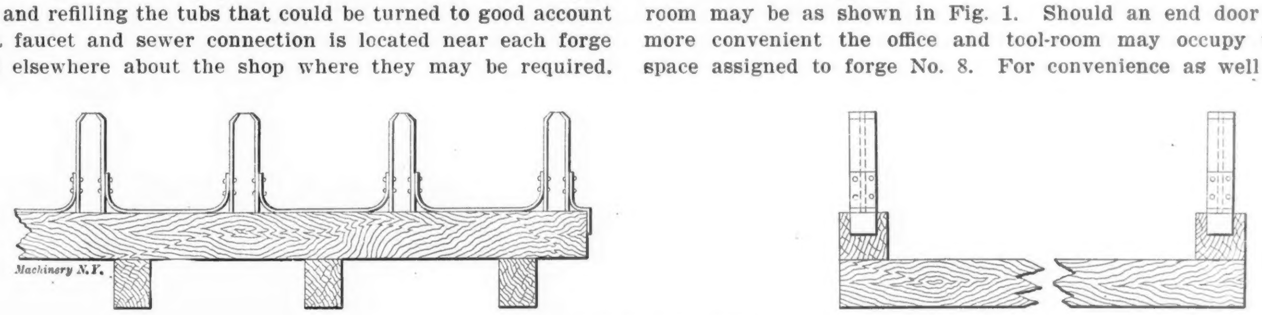


Fig. 9. Rack for Heavy Bars

Flooring

There is much difference of opinion as to the material that is best adapted for the flooring of blacksmith shops. Wood is too inflammable, bricks crack and break from the heat and impact of work being laid upon them, cement or concrete is poorly adapted for the same reason, and asphalt is out of the

question. Nothing that has been tried so far has given better satisfaction or can be installed at less cost than dirt mixed with ashes. If kept moist by being watered at least once every day it is more comfortable to stand upon than anything else that can be used for the purpose. It is easily repaired and leveled should holes or irregularities get worn in it, and it is not affected in the least by hot or heavy pieces of work or material being dropped or laid upon it. The space between walls and forges, however, may be covered with concrete and cement to facilitate the handling of such appliances as portable surface-plates and vises, and the floor of wash-rooms and lavatories may be of asphalt, while the foreman's office and tool-room may be of wood.

The spaces assigned to cutting-off machinery, etc., and that for drop-hammers and other machines used in making die forgings has not been laid out in detail for the reason that machines for that class of work vary so much in general outline and in size that it would be difficult to arrange them satisfactorily except by knowing their makes and the size of work they are to be used for.

Bar Stock Racks and Storage

In storing bar stock several things have to be considered if time is to be saved and the chances of making mistakes in using wrong material minimized. Racks are necessary for the purpose and should be constructed in a manner best suited for the accommodation of the various kinds of material and so that bars can be lifted from the sides instead of having to be pulled from the end, as must be done when the common lattice pattern rack is used. For tool steel or any other special material racks of the type shown in Fig. 6 will be found to be the most convenient, as bars can be stood on end irrespective of length, and short pieces kept in the enclosed portion at the bottom. For the more ordinary grades of stock up to a certain size a rack of the type shown in Figs. 7 and 8 will be found to be very convenient, as bars can be removed from the sides, which is much more expedient than pulling them from the ends. Lengths too short to be supported by the arms can be placed in the box-shaped receptacle at the base. For bars too heavy to be stored upon racks of the types already shown a platform raised a little above the level of the floor and divided into sections by upright stakes, which may either be of cast iron or steel of structural shapes as shown in Fig. 9, may be used. All material to be designated by colors on the ends of the bars to correspond with the colors of the racks in which they are stored.

Communication between the stock-room and cutting-off department should be through sliding doors that would permit of bars too heavy to be lifted by hand, being lifted and conveyed between the two places by an overhead trolley system, to pass through the sliding doors at the point where they come together.

Fuel Storage—Roof Construction

On the opposite side of the building from the bar stock store are the pockets for storing coal, coke, charcoal or any of the other solid fuels that may be used. The approach to these pockets is a line of standard gage car tracks elevated upon trestle work and entering the building through a door in the end wall above the level of the pockets as shown in Fig. 4, this door to be large enough to admit locomotive and cars so that coal, etc., could be dumped directly into the pockets from which it could be supplied to forges or furnaces by hand cars.

The roofing of a building as here depicted apart from general outlines is a subject upon which the constructing engineer ought to be left with a free hand, as stresses must be calculated and tension and compression members of the trusses arranged accordingly. The sides of the ventilating monitor, however, should be at least 6 feet in height to admit of the windows used being of a size sufficient to throw good light upon the anvils at the opposite sides of the shop. These windows should be balanced upon horizontal trunnions so that they could be opened and closed by means of cords or rods operated from the floor.

* * *

The value of the present output of automobiles is estimated to be about $130,000,000 yearly.

HOW OLD SI WAS NEARLY "OSLERIZED"

A. S. ATKINSON*

Native ability is something that is quite scarce in the average machine shop, or at least if it is there it is smothered up or held in check or choked by too much rule-by-measurement practice. Of course I don't mean the ability to run a machine, cut after a pattern, or do any of the other routine work that must make up most of the day's labor in nine cases out of ten. Old Si Smith used to define native ability as "the knack of making something out of nothing." Si had this kind of ability. He was of the old school, hadn't been trained and schooled in an industrial college, and when he served his apprenticeship in the shop there weren't one hundredth as many machines to do your work as there are to-day. A man then had to get out and be his own boring machine, lathe, and planer. There wasn't any monotony about a machinist's job then. Likely as not one day you'd have to weld together a broken rod in the blacksmith's shop or hammer a new point onto a broken bit, and the next you'd be patching up a boiler plate or riveting a steam box to keep it from bursting, or you'd be doing almost anything from filing and scraping down a rough piston to making a new sheet-iron box. There was no standing before a huge machine and watching its rhythmic cutting and pounding, hour after hour.

The old school developed native ability, if one had it in him, and sometimes it knocked a little into one who didn't inherit any from birth. It may be the new method is better for turning out great quantities of exact work, but the day of the man with the knack for doing things has gone for good. Not entirely though—at least one such man is essential to the success of every shop. Just to prove this I will recall some little experiences in which old Si figured. The old superintendent understood Si, and instead of looking upon him as a back number who ought to be "Oslerized," he valued his services for all they were worth. He was always sure of his position in that shop. But the old superintendent died, and another, a stranger to most of us, came to take his place, and with him a new foreman who was about as much a stranger as the head boss. They were both younger than their predecessors, and they believed in hustle and bustle, and method and system. They put everything and everybody to checking off everything and everybody else. They said they wanted to know how much each man was doing, and how much each article cost. I suppose it was all right, as it was modern and progressive. Most of us were young enough to adapt ourselves to the new way and not let it bother us. But it came rather hard on old Si Smith. Si couldn't understand it. He didn't know why he had to be watched and why he had to jot down on a paper everything he did—the time, date, and number of minutes. He protested in vain. "I've been here forty years, an' I never cheated the boss out of an hour of time. I do my work honestly." But this was of no use. "I believe you're honest, Si," the foreman replied not unkindly, "but how do we know whether you're doing your share of the work. It's not so much a question of good intentions as of capacity and efficiency." That stumped Si, and he only stared back stupidly. "What does he mean?" he asked appealingly of us at the noon hour. "Does he mean I don't understand my job or that I ain't up to date, or—or—or—"

Poor Si! We tried to relieve his mind, but it was a dismal failure. Si's particular specialty was fine, careful work. He was not a fast worker, but nothing left his bench until it was perfect. He loved it, and when he did a bit of welding or polishing or cutting with hand tools, it was a pleasure to look at it. He had the machines beat to a standstill. If a machine could cut out a dye to a hundredth of an inch, Si could cut another by hand that would come within a thousandth of an inch of perfection. Why, tools in his hands took life and precision that made the work of the rest of us clumsy and bungling. Of course that didn't count in a shop where a new and unsympathetic foreman and superintendent had taken charge. Si couldn't keep up with the pace. His time cards soon showed that. He was slow in his fine work, and at the end of each week the record went against him. You

* Address: P. O. Box 1189, New York City.

see, by their new system, they could tell just how much work each man was doing, and if one was loafing on his job he was told to hustle. It was all intended to increase the speed and weed out the slow ones. The most of the trouble fell upon Si, and within a few months we began to feel sorry for the old fellow. The constant prodding and reprimanding was getting onto his nerves, and that made him slower than ever. This increased his digrace, and then one day the crisis was reached. Old Si was to be "Oslerized," but owing to his long service in the shop it was only a modified process. He was given a month's vacation on full wages, and at the end of that period he was to return as watchman at a big reduction in wages. We didn't hear the words of the interview. Si was too surprised and dumbfounded to say much; he had to get out and think it over. Then he exploded before us. "They make me watchman on half pay," he said angrily. "Me a watchman, an' too old an' slow to do anything else. I'll go an' drown myself first. No, I'll go to another shop an' get work."

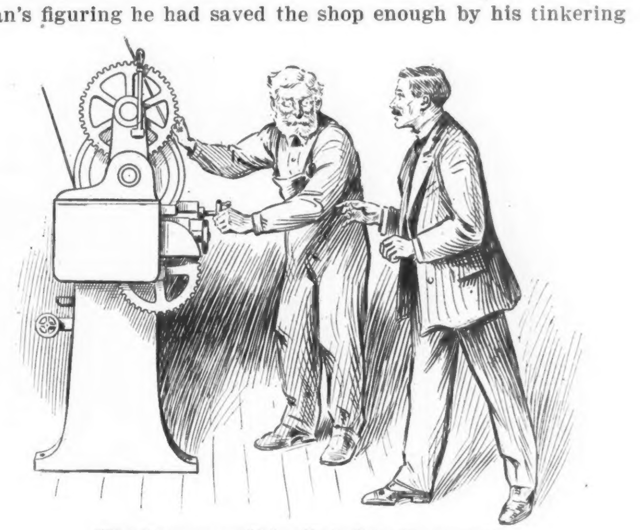
"Does he mean I don't understand my job, or that I ain't up to date?"

This determination we tried to combat, advising Si to think it over and not decide too hastily. He had a month to decide. But he was angry, and he spent a week going from shop to shop for work. But nobody wanted a machinist of Si's age, and they knew nothing about his skill. The following Monday morning Si returned to the shop. He was crestfallen and quiet; he knew now that he had little chance in the new industrial work. "But, Si," we protested, "you have three weeks more of vacation. What are you doing here?" "Vacation?" he stammered. "Oh, yes, I'm having a vacation; I'll spend it here roun' the old shop. There ain't nothing to do but sit aroun' an' look on. I get homesick when I'm away, but I'll have my vacation all right." This, in substance, he repeated to the foreman when he asked Si why he was back. The foreman smiled, and let the old fellow have his way. He was harmless, and so long as he didn't interfere with the work of the others he could hang around and look on. Probably he wanted to get some points from the younger men about increasing his capacity and efficiency.

Now Si's method of looking on was quite different from that of most men. If anything went wrong with a machine he would jump up and look for the trouble. He had an ear tuned so exactly that he could almost anticipate trouble with a machine. The lineshaft couldn't miss a revolution or a gas engine skip once in the most distant part of the building without Si knew it. Once a belt slipped so near the edge of its pulley that it came into contact with a loose guide and bent it out of position. The operator didn't notice it, but Si did. In another minute there would have been trouble, but old Si jumped up and stopped the machine just as the belt slipped off and landed where it would have been caught in another machine. The foreman came up frowning and Si offered only as an explanation: "I saw that belt slipping and stopped it. Them guides ain't no good anyway." The foreman understood the importance of this sudden interference, but said nothing. Si disappeared then into the forge shop. That night after work hours he appeared with a new set of guides which he proceeded to put up. They were so strong and good that they are doing service to-day. Si had forged them out of old metal, and they cost the firm nothing.

On the third day of Si's vacation in the shop a big turret lathe snapped one of its back gears and put it instantly out of commission. We had rush orders on hand, and the crippling of this machine put us in a bad position, as there were no duplicate parts on hand. The foreman was upset, and the superintendent, too. Orders were telegraphed to the manufacturers, but it would mean a loss of several days at least. While the others were bemoaning the fact that the turret lathe would shut down a good deal of the work, old Si was peering into the machine and taking mental notes. When the old thing was abandoned, Si took the fractured parts into the blacksmith's shop, and for several hours was busy. Toward night he returned, black with dirt and grime, and the perspiration running in streaks down his face. He carried something in his hands. Nobody noticed him particularly, but just before the hour for shutting down arrived we were all surprised by hearing the old turret lathe start up and begin rhythmic operations again. The foreman rushed to the place, and there he found old Si beaming happily. "I guess she'll run all right for a few days," he said, pushing his spectacles up on his greasy forehead.

The foreman could hardly believe his senses. He had to stop the machine and get Si to show him what he had done. Oh, it was simple. He had brazed the broken gear until it was almost as strong as a new one—certainly good enough for an emergency. That night a volunteer crew ran the old turret lathe and caught up with the rest of the work. It was nearly a week before the manufacturers' expert appeared on the scene with new back gears, and it took him two days to put them in and finish his job. The foreman after watching the repairs, took a pencil from his pocket and began to do some figuring. We could only guess what it was about. Si didn't know either, but the next day the foreman and superintendent had a conference, the result of which was that old Si was called in the office for a short talk. They had decided that they couldn't afford to lose Si. According to the foreman's figuring he had saved the shop enough by his tinkering



"The foreman could hardly believe his senses"

to pay for his salary several months. There had been danger of losing an important order through the mishap, and Si saved that for them. Si was put back into the machine shop, and he is there now. The Lord knows how old he is; he must be long past the sixty mark, and yet he's as useful as ever. He can't hold his end upon piece work to-day, and nearly every youngster in the shop can beat him. But when they want some very fine piece of work done it is turned over to old Si, and when there's trouble with the machines Si is the expert called in, and its a pretty bad case of breakdown that he can't fix up. He can turn his abilities to almost anything, and when he prescribes medicine the patient generally recovers in a short time.

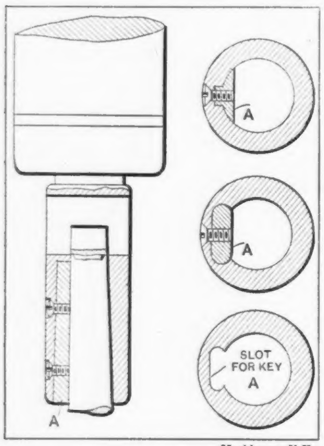
We called him "old saw bones," for he was a surgeon—more than a physician. He could fix up a broken leg or rod or weld together any fracture so that you would hardly see a scar. That is what I call native ability. Si had it, and it certainly was "the knack of making something out of noth-

ing." If he didn't have the right piece of metal to fix a thing he'd make a piece out of old scrap or anything else handy. A shop that doesn't have an "old saw bones" in it is minus one of the most important factors. Give me one of the old school machinists who knows how to handle tools for mending anything, and in the end he will save more than his salary is worth twice over. There are a good many such old men tinkering around, but unfortunately their breed is dying out, and I suppose in time there will be none left. Then we'll have to depend upon the experts from the manufacturers, who will charge a big price and hold up operations for several days or a week every time something goes wrong.

* * *

DRILL SOCKET

Harold E. Bradley has assigned to the Morse Twist Drill Co., New Bedford, Mass., his patented drill socket described in U. S. patent No. 926,845, July 6, 1909. The object of this invention is to provide a drill socket or collet which in addition to its regular function of driving the drill by the tang or flattened end, is also adapted to receive and drive a drill with a broken tang, thus utilizing drills which would otherwise be worthless. The illustration shows a vertical section of the improved socket, and also horizontal sections of alternative designs. The novel feature is the key *A*, which can be readily inserted in grooves in the socket and held in position by screws. After one side of the drill shank is ground or flattened off to correspond with the flat of the key, the drill may be again inserted and driven by the socket.



Drill Socket adapted for driving Regular Taper Shank Twist Drills and Drills with Broken Tangs

* * *

DIES AND PUNCHES FOR MAKING NUTS

One of the latest improvements for automatically making nuts from a bar of metal by dies and punches was patented by George Dunham, Unionville, Conn. (U. S. patent No. 928,509, July 20, 1909). The dies and punches are adapted for an ordinary double crank machine having two horizontally moving punch slides.

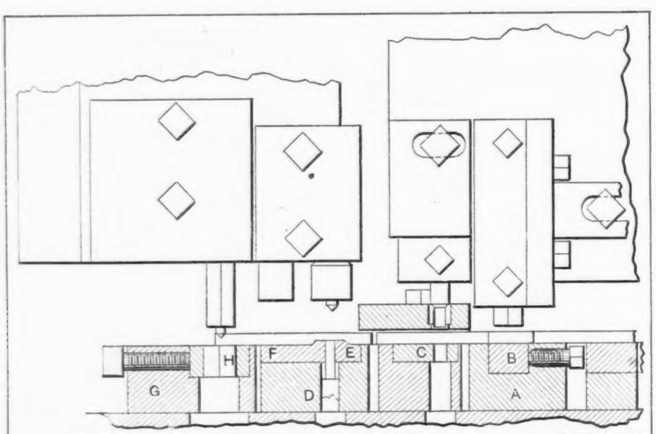


Fig. 1. Sectional View of Dies and Punches for Making Nuts

Fig. 1 is a vertical section of the dies on the bed plate with the punches above. At the right is a die holder *A* with a die *B* having two V-shaped cutting edges, the apices of which face each other. This die cuts V-shaped notches in the opposite edges of the bar and is called the notching die. While each notching punch has four cutting edges, only two of the edges can be used at one time. Adjacent to the notching die is a die *C* with a die block; this die has a round hole for punching the center hole of the nut blanks. The next die holder *D* has a crowning die *E* and a flattening die *F*, the two preferably being made in one piece. The fourth and last die holder *G* has a die *H* for cutting the nut from the bar.

Fig. 2 is a bar illustrating the various steps taken in making the nuts. The notches *d* and the round hole in the nut blank are made by one blow of the right-hand slide. The blank *b* is crowned and the blank *c* flattened by one blow of the left-hand slide. The nut blank *a* is then cut off and trimmed. The next blow of the two slides will form one more pair of notches and perform the previous operations on the blanks *f*, *g*, *h* and *k*. By changing the dies and punches any desired form of nut may be obtained. Square nuts may be made by omitting the notching punches and substituting a trimming die and punch of a square form for the hexagonal one shown.

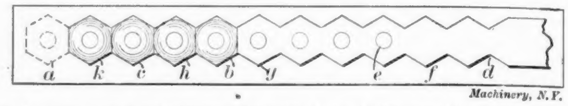


Fig. 2. Bar, showing Different Stages in the Making of Nuts by Punching

* * *

BORING ELLIPTICAL HOLES

A lathe attachment for boring elliptical holes is described by James Shaw, Dauphin, Manitoba, in U. S. patent No. 928,404, July 20, 1909. The attachment as fitted to a lathe is shown in Fig. 1, and consists essentially of movable supports *A* and *B*, and a boring bar *C* with eccentric end bearings. Fig. 2 is a longitudinal section through the bearing brackets showing boring bar *C*. The ends *D* and *E* are eccentric to *C* and are in alignment longitudinally the one with the other. It will be noticed that *D* and *E* are carried by bearings which can be raised vertically in guideways at the rear face of the supports, while at the other face the main shaft has bearings with horizontal guideways. When the device is in operation the sliding bearings are free to move in their respective ways. In the main shaft is a hole for the cutting tool (see Fig. 2), and in Fig. 1 the tool is shown in position boring an elliptical hole in the work on the lathe carriage.

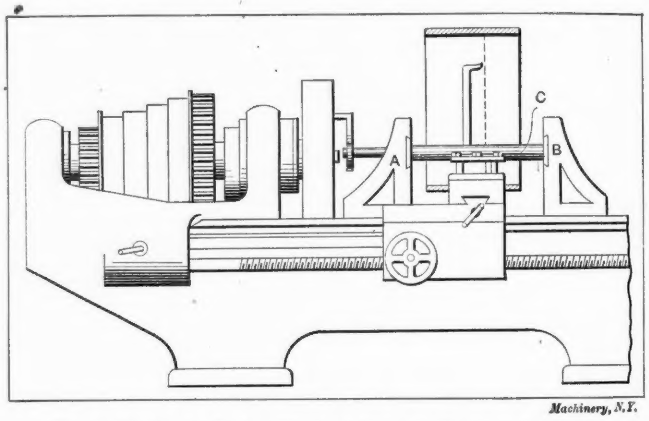


Fig. 1. Device for Boring Elliptical Holes in Place on the Lathe

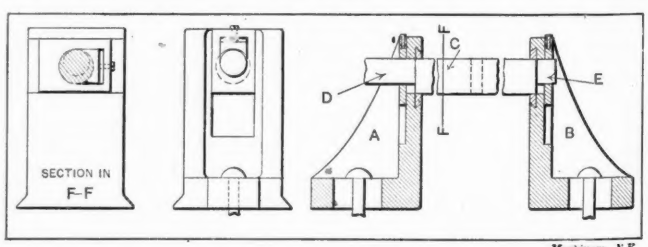


Fig. 2. End and Sectional Views of Elliptical Boring Device

* * *

The chief item of expense in the maintenance of automobiles is generally the tires. Mr. Charles Clifton, president of the Association of Licensed Automobile Manufacturers, says that there are three prime factors responsible for short tire life: First, excessive speed, especially in hot weather; second, rounding curves at a high rate of speed; and third, unnecessary use of mechanical brakes.

MAKING PISTON PACKING RINGS

E. B.

The accompanying engravings illustrate a cheap and rapid method of making expansion rings. This method has been used for some time by a certain gas engine company, and has done much toward reducing the costs of this class of work. Referring to Fig. 1, the dotted lines *A* indicate the shape of the casting from which the rings are made. This consists of a cast-iron cylinder with a flange on one end to facilitate clamping in the chuck for turning and boring. Having chucked the casting in the lathe, the rings are then turned and bored in one operation by means of the tool shown. This tool consists of a frame *D*, which is rigidly connected to the tool carriage and is fed along in the same manner as any other tool. Through this frame passes a spindle *C*, which turns freely in the frame and is held from moving lengthwise by means of a pin *K*, which fits into a recess cut in the spindle. On one end of this spindle there is an eccentric collar *D* which is rigidly held by a pin, thus turning with the spindle. The other end of the spindle is cut square or to some other shape to fit a block with a hole of the same shape, which is fastened to the chuck head. Therefore when the tool is fed along, this spindle slides into the chuck head, and at the same time revolves with it, as does the casting *A*.

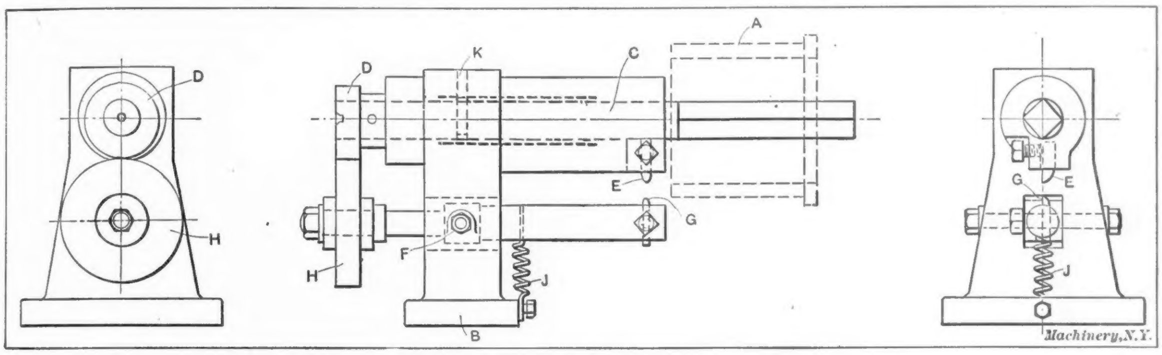


Fig. 1. Tool for Boring and Turning Eccentric Rings simultaneously

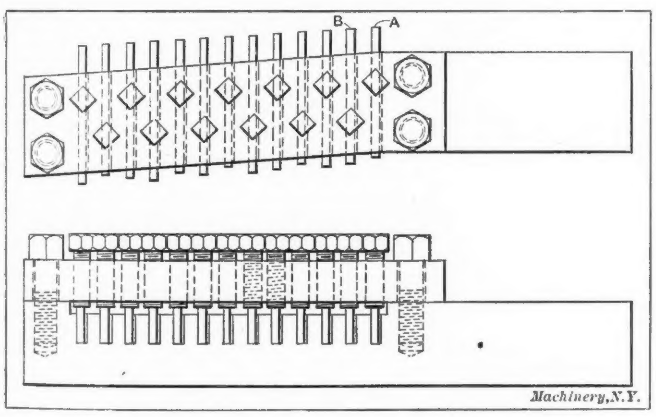


Fig. 2. Cutting-off Tool for Severing the Rings successively

When the casting makes one revolution, the spindle and eccentric also make one revolution. In the frame is set a tool *E* which bores the casting. Through the lower part of the frame passes another spindle or lever which is hinged at *F* and has a tool *G* on one end and a roller *H* on the other end which turns freely on this lever. A spring *J* holds the roller *H* up against the eccentric *D*. As stated before, the eccentric makes one revolution to each revolution of the casting, therefore the lever and tool *G* perform one complete oscillation to every turn of the casting. The tool therefore turns the casting eccentric to an amount depending on the location of the fulcrum *F* and the eccentricity of the cam *D*. This can be better understood if we assume the casting *A*, spindle *C*, and eccentric *D* to be stationary, and the frame *B* to revolve about the spindle. The path of the turning tool would then be in a circle eccentric with the axis of *C*. Therefore, if the frame *B* is stationary and the work *A* revolves, then the outer surface of the cylinder will be cut eccentric to its axis. In this way the casting is turned and bored in one operation.

The next operation is to cut off the rings, and this is done by means of the tool shown in Fig. 2. This tool consists of a bar in which are mounted a number of cut-off tools spaced the proper distance apart to give the desired width of ring. The holder is bent and the tools are set successively at greater distances from the axis of the work. Therefore the tool *A* gets through first and the first ring drops off, and the other rings, throughout the entire length of the casting, are severed in succession.

The next step is to split the rings on the thin side; they are then ready to be ground on the outside. To facilitate this operation a casting, Fig. 3, is bored to such a diameter as will allow for the amount to be ground off. The rings are then sprung into this cylinder as shown by the dotted lines.

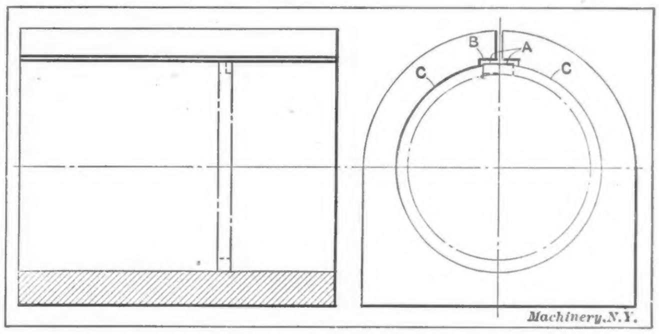


Fig. 3. Fixture for Holding the Rings while they are being secured in the Grinding Arbor

In springing the rings together the points *A* move outside the circle of the bore and the slot *B* is cut in the casting to allow them to do so. This is an important point because if this slot were not provided the points *A* would be forced in and ground to a true circle with the remainder of the ring, with the result that when the rings were placed on the piston and inserted in the engine cylinder the points *A* would rub on the cylinder walls and a part of the ring, say from *A* to *C*, would be held away and the fit would not be perfect. But if these corners are allowed to project as shown, they will be ground away and will therefore not rub afterward.

Having placed a number of rings in this assembler, an arbor, Fig. 4, is inserted and the rings clamped together between the collars *A* and *B*. The arbor is then placed in the grinding machine and a light cut is taken off the rings. These collars *A* and *B* just fit the cylinder, Fig. 3; and the rings are therefore accurately centered at once. The collars are cut away at *C* to allow the grinding wheel to pass over the rings without cutting away the collars and destroying their usefulness as a centering device.

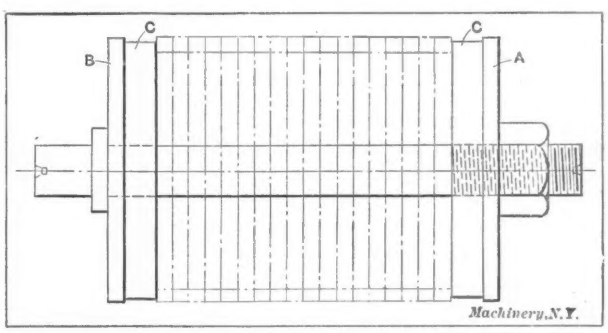


Fig. 4. Arbor which holds the Rings while they are being ground

Rings made in this way have given most excellent satisfaction and fit the engine cylinder perfectly.

Entered at the Post-Office in New York City as Second-Class Mail Matter.

MACHINERY

DESIGN—CONSTRUCTION—OPERATION.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

49-55 LAFAYETTE STREET, CORNER OF LEONARD, NEW YORK CITY.

Alexander Luchars, President and Treasurer.
Matthew J. O'Neill, Secretary.

Fred E. Rogers, Editor.
Ralph E. Flanders, Erik Oberg, Franklin D. Jones, Ethan Viall, Associate Editors.

The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit exclusive contributions from practical men on subjects pertaining to machine shop practice and machine design. All accepted matter is paid for at our regular space rates unless other terms are agreed on. All copy must reach us by the 5th of the month preceding publication.

OCTOBER, 1909

PAID CIRCULATION FOR SEPT., 1909, 20,449 COPIES

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 650 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, and about 250 pages a year of additional matter, and forty-eight 6 x 9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. RAILWAY MACHINERY, $2.00 a year, is a special edition, including a variety of matter for railway shop work—same size as Engineering and same number of data sheets.

HEAT TREATMENT OF ALLOY STEEL

The rapid development of the automobile industry in America has awakened a quick, keen appreciation of the great importance of proper heat treatment of steel. It is pointed out by Mr. Henry Souther that scientific heat treatment is quite as essential as the quality of steel. Ordinary steel may acquire good physical qualities with proper heat treatment, and the best of steel can be ruined by defective methods. There must be thoroughness in the various operations of annealing, hardening and tempering, for treatment carried on with care only makes uniformity of product possible. This is particularly true in the production of drop forgings.

The difference between ordinary steel and the best is great. For example, the elastic limit of ordinary steel is about 40,000 pounds per square inch with a reduction of area of, say, 50 per cent. Nickel steel properly heat treated has an elastic limit of 80,000 to 100,000 pounds per square inch of section, with a reduction of area of 50 per cent, or more. Brittleness does not follow proper heat treatment, the enduring quality being increased in a greater ratio than the elastic limit. Consequently crystallization, fatigue, or whatever we name the cause of breakage, is less likely to develop in a properly heat-treated and tempered material than in an annealed and soft material. This fact, discovered in the laboratory and established in actual practice, is now commonly accepted by metallurgical experts, notwithstanding that it completely overturns previous general belief. Another commonly accepted belief disproved is that strength and stiffness are coordinate, or "the stronger a piece of steel, the stiffer it is." To illustrate, it was thought if one piece of steel were twice as strong as another, it would bend only one-half as much under a given weight. But actual test has shown that a chrome-nickel steel having an elastic limit of 150,000 pounds or more per square inch of section, bends under a given load the same amount as a carbon steel specimen, and this condition holds true as long as the load is within the elastic limit of the weaker material. The elastic limit of a well-tempered steel spring is about 150,000 pounds per square inch, but a spring can be made of soft steel. If it is not loaded beyond its elastic limit, the spring will return to its original shape after every deflection, but the deflection would not be sufficient to make a good spring. In fact, it would be hardly noticeable, and of course, would be of little value.

Between these extremes lie the steels used by the spring makers in the past. Not only has the automobile industry forced the spring makers to depart from their old materials and methods, but the "shake-up" extends all along the line. Assume that a 0.20 carbon steel has been used with advantage for a given design of crank-shaft, neither bending nor breaking through long continued use, and that the bearing surfaces are as small in area as can be used without heating or excessive wear. A crank-shaft of properly treated chrome-nickel steel, having an elastic limit four or five times as high as the 0.20 carbon steel would be no stiffer, but would have greatly increased life and reliability. The steel makers must be prepared to meet these new conditions. Sound knowledge of steel has spread fast among intelligent manufacturers; from the knowledge obtained in the laboratories established where all materials are physically and chemically tested they have learned to discriminate in selection. With known characteristics, heat treatment scientifically conducted is sure of results that make high-grade steels comparable with ordinary steels in about the ratio they, in turn, bear to cast iron.

* * *

THE VALUE OF THE TRADE PRESS

The following quotation from the *Journal of Commerce*, New York, is an unprejudiced statement of the functions of the trade press:

In the very nature of things the man of affairs, with multitudinous and various cares pressing sorely on his time and attention, necessarily becomes self-centered and preoccupied. This is the man for whom the trade press stands as an invaluable ally. While he digs and delves in his own tasks, the trade press is his reliance for more basic information than he imagines. The ordinary press gives him the products of its daily observations in the doings and misdoings of the big round world of politics and society, but what it brings is only a diversion; a stepping aside from his grind. It may refresh him, but it does not aid him in his money-making slavery. But the trade press has an entirely different function in his life. While he toils in his office or warehouse the trade press is performing for him the task of confidential messenger to the rest of the commercial world. Its human machinery is finely tempered and carefully adjusted. Its men are trained, not merely in the collection of interesting facts of ordinary happenings, but in the observation of those events and developments which have a direct bearing on the commercial side of life. The trade press is his organ of communication outward as well as inward. Circulating, as it does, both in a local field and throughout the country, he has but to say the word and his message is disseminated among the very men most interested in his ideas. No man who has ever watched the development of any great trade movement can deny that, without an intelligent, trustworthy trade press, it would have been impossible.

Especially applicable is the description, "an intelligent, trustworthy trade press." The value of the trade journal to the industry it represents is based almost entirely on its trustworthiness. The same carelessness in regard to fact and the tendency to exaggeration which characterize the daily press, would so affect the influence of a trade journal with its readers as to materially reduce its value as a property in a short time. Trustworthiness, accuracy and the qualities which make for reliability, are demanded by the readers of the technical press; and the smallest mistake in a figure or calculation seldom escapes attention.

It is a noteworthy fact that no house organ, or publication issued in the interests of a manufacturer or dealer, has yet developed into a great trade journal. The publications to which the latter term may be applied, we believe, without exception, have started as independent journals, and their development has been strictly along that line. The stronger they grew, the more truly independent they became.

* * *

The growth of the automobile industry is one of the most amazing features of modern manufacturing industry. About 75,000 cars were built in 1909, and, according to the statement of Mr. Alfred Reeves, general manager of the American Motor Car Manufacturers' Association, manufacturers plan to place 200,000 automobiles on the market in 1910.

THE PNEUMATIC TIRE AND THE AEROPLANE

It seems a far cry from the bicycle tire to the aeroplane in the sense that the former is to any degree concerned with the development of the latter, but, according to one who has given the matter some serious thought, it appears that the connection between the pneumatic tire and the flying machine can be logically established. The fact that the automobile is an intermediary in the evolution that has made the latest mechanical triumph possible is interesting now, and it will not be unprofitable to briefly trace the evolutionary process that has made flight actually possible under favorable conditions, and which has aroused high hopes of ultimately making it a practicable means of travel.

The early bicycles of the high-wheel variety were facetiously named "bone-shakers," and bone-shakers they were in truth. The bicycle was only moderately popular in favored places having smooth roads and specially constructed tracks, until the advent of the "safety" and pneumatic tire. The new tire transformed the bicycle from a hard-riding machine, extremely fatiguing to all but those of strong physique, to a vehicle of business and pleasure for young and old of both sexes.

The wonderful improvement in riding quality made in the bicycle by the pneumatic tire stimulated the efforts of inventors and designers to produce a practicable four-wheel carriage driven by power to replace the horse-drawn wagon, and the "tires of air" literally smoothed away some of the great difficulties that had made the horseless wagon impracticable before.

When the running-gear problem was in a fair state of development, attention was concentrated on the motive power, and after a few years of strenuous competition the steam engine gave way to the internal combustion motor which won out because of its simpler control, higher efficiency and greater power per unit of weight. To-day the automobile gas engine is the world's wonder for concentration of power and simplicity of construction. In the space occupied by a Saratoga trunk can be placed a motor capable of generating 40 to 50 H. P. and weighing only from 8 to 10 pounds per horse-power.

Observers of birds and bird flight long ago took note of the strength of their wing muscles and apparent ability to exert great muscular effort in proportion to weight. Whether birds actually exert much power to sustain themselves when once in flight is a mooted question, but it is easily proved that they must expend great effort in the first few moments when rising in the air and getting in motion.

The heavier-than-air flying machine requires a powerful, light motor to launch it into the atmosphere and to sustain motion. The gas motor developed to meet the needs of the automobile required only further development to fit the special needs of aviation. As a matter of fact that development has been going on simultaneously in automobile, motor-cycle and aeroplane motors, and the leaders in mechanical flight might well contend that their share in the development of the gas engine is by no means small. Whether the chain of events thus outlined actually put the aeroplane in debt to the pneumatic tire, we shall leave to our readers to decide for themselves; but whatever the conclusion, the tracing of mechanical developments to imagined or real sources leads to some curious discoveries. One is forced to believe that many of the apparently trivial devices, in their infancy, have been the germs from which the most important developments have come.

* * *

THE COST OF SPECIAL TOOLS

Before deciding upon the design of special tools for manufacturing purposes, it is very important to compare the saving expected to result from the use of the new tool, with the cost of building the tool itself. A writer in MACHINERY in a recent series of articles on jigs and fixtures refers to this matter as follows: "Before planning the design of a tool, compare the cost of production, using present tools, with the expected cost of production using the tools to be made, and see that the cost of building the new tool is not in excess of the expected gain." This rule seems so simple and elementary that it is difficult to explain why it is so often disregarded.

As a concrete example of the meaning of the rule laid down above and the results produced when it is disregarded, the following occurrence in a prominent machine tool building shop may be of interest: A certain machine detail was produced in a slotting machine by means of a fixture costing $35. Ten pieces were produced per hour, the price per piece, including over-head expense, but not interest and depreciation of the fixture, being eight cents. The head tool-designer of the concern conceived the idea of a special fixture for producing these parts much more rapidly on a milling machine. Considerable experimenting, however, was necessary, and the total cost of the new fixture when completed was $518. This fixture made it possible to produce twenty pieces per hour, or double the number made by the old fixture. Consequently the price per piece is only four cents when the new fixture is used, interest and depreciation of the fixture itself not being considered, and a saving of four cents a piece is made possible. This would be a considerable saving if the fixture were constantly in use, but only 300 of these parts are required each year, so that the total saving resulting from the use of the fixture amounts to only $12 a year, and the fixture is in use for only fifteen hours during the whole year. Five per cent interest on $518 is $25.90, and if the manufacturing company expects this rate of interest, at least, on its investment, it will be seen that the use of the new fixture actually entails a loss of $13.90 per year, not considering depreciation and the fact that the labor necessary to build it could have been used to better advantage for other purposes. The depreciation may perhaps be considered as practically eliminated, because the fixture is used only for a few hours during the whole year.

This incident plainly illustrates the importance of determining closely the cost of a tool before it is designed and built, and the saving to be effected by its use. The designer, however, is not always directly responsible for the waste entailed when this cardinal principle of economical tool designing is overlooked. As is well known, the designer is often not permitted free access to the cost accounts, and this policy is largely responsible for some misdirected efforts of his energy. Often he does not know the present cost of doing certain work, and is given no opportunity to find out; yet he is expected to design tools for improved methods of performing the work. In such cases the designer cannot be held wholly responsible for inefficient and uneconomical results. That responsibility then falls on the man "higher up," who considers that anything relating to the economics of the concern should be strictly confined within the four walls of the cost-keeping department.

* * *

PRIZE FOR A SAFETY AUTOMOBILE CRANK

A French association for the prevention of accidents in industrial work has offered $300 in prizes for a crank or safety device for hoists, cranes, and all forms of lifting apparatus, and also for explosion motors, which shall, in the first case automatically stop the descent of the load, or in the second case, throw out of gear the driving action when not required. The invention remains the property of the competitor, who must himself be responsible for its due protection by patents. Drawings of competitive devices should be sent to the office of the Association des Industriels de France contre les Accidents du Travail, 4, Boulevard Saint-André, Paris, France. A non-return starting crank for gas engines, of simple design, was illustrated in the January, 1906, issue of MACHINERY; prospective competitors may be interested in studying this design in order to see what has already been done along these lines.

* * *

"John Brown, Practical Plumber," "James Smith, Practical Horseshoer," "Robert Jones, Practical Gunsmith," etc., are samples of signs found wherever we go that show a misunderstanding of the word "practical" or a deliberate misuse of the word for which there is no good excuse. If a man is a plumber, or a horseshoer or a gunsmith, he must be practical and follow practicable methods. Who ever heard of a theoretical plumber, or a horseshoer who shod horses by absent treatment, or a gunsmith who took dents out of gun barrels by suggestion? Drop the misused word "practical" from signs and see if they are not just as strong and comprehensive as before.

EFFICIENT SYSTEM FOR THE RAPID ASSEMBLY OF MOTOR CARS*

HAROLD WHITING SLAUSON†

From a mere corner in the machine shop in the days when the automobile was built in lots of but two or three at a time, the assembling room has grown to such an extent that, in many factories where the output is large, it occupies an entire floor of the main building, and has come to be considered as one of the three or four most important departments of a modern motor car factory. A corresponding increase in responsibility has attended the growth in size and importance of the assembling room, and today, unless well managed and equipped with the most up-to-date devices for the convenient and rapid handling of parts, it can easily "eat up" the profits on a whole year's output of low or medium-priced cars. Without requiring the services of an excessive number of men, it must take care of the parts from the machine shop and the parts-assembling room as they are turned out, and not allow a great number of finished pieces to accumulate at any time in the stock room. The work of assembling must also be done thoroughly, so that, when tested, the complete car need not be sent back for overhauling and readjustment of parts. In short, the assembling room must work in harmony with each of the other departments in doing its share toward producing a car of maximum quality at minimum cost of production—and that share is by no means small. But not alone are the best systems and business management, proper interior arrangement and most up-to-date devices necessary, but the highest class of skilled mechanics must be employed as well. A motor and transmission may be composed of the best of materials and have bestowed upon them the most skilled workmanship available, but unless they are placed together in the completed car with each shaft lined up, each bearing scraped and fitted and each gear in position to mesh properly, all this expensive material and labor may count for naught. The assembling room cannot, to any great extent, compensate for poor machining, but it *can* absolutely ruin the best products of the machine shop.

That the leading automobile manufacturers have been brought to a realization of the importance of the use of the best systems, equipment and labor in their assembling rooms is particularly well exemplified in the factory of the Chalmers-Detroit Motor Car Company at Detroit, Mich. Probably the most convincing proof of this statement will be found in the fact that, for the 3,000 complete cars turned out by this company last year, not more than 30 men were employed at any one time on the assembling room floor. More remarkable than this, however, is the high record established for a day's work. In ten hours, the 30 men in this department assembled 35 complete cars! Of course this does not include the assembling of the various small parts of the motor, transmission and rear axle, as these are taken care of in other departments, but when it is remembered that the chassis assembly *does* include the installation of all these parts in the frame, the adjustment of each to its new position, the attaching of all springs, wheels, running-boards, foot-rests, steering gear, and the wiring and piping of the motor, it will be realized that the system and equipment employed in this department of the Chalmers-Detroit factory must be perfect in every respect in order to turn out this amount of completed work.

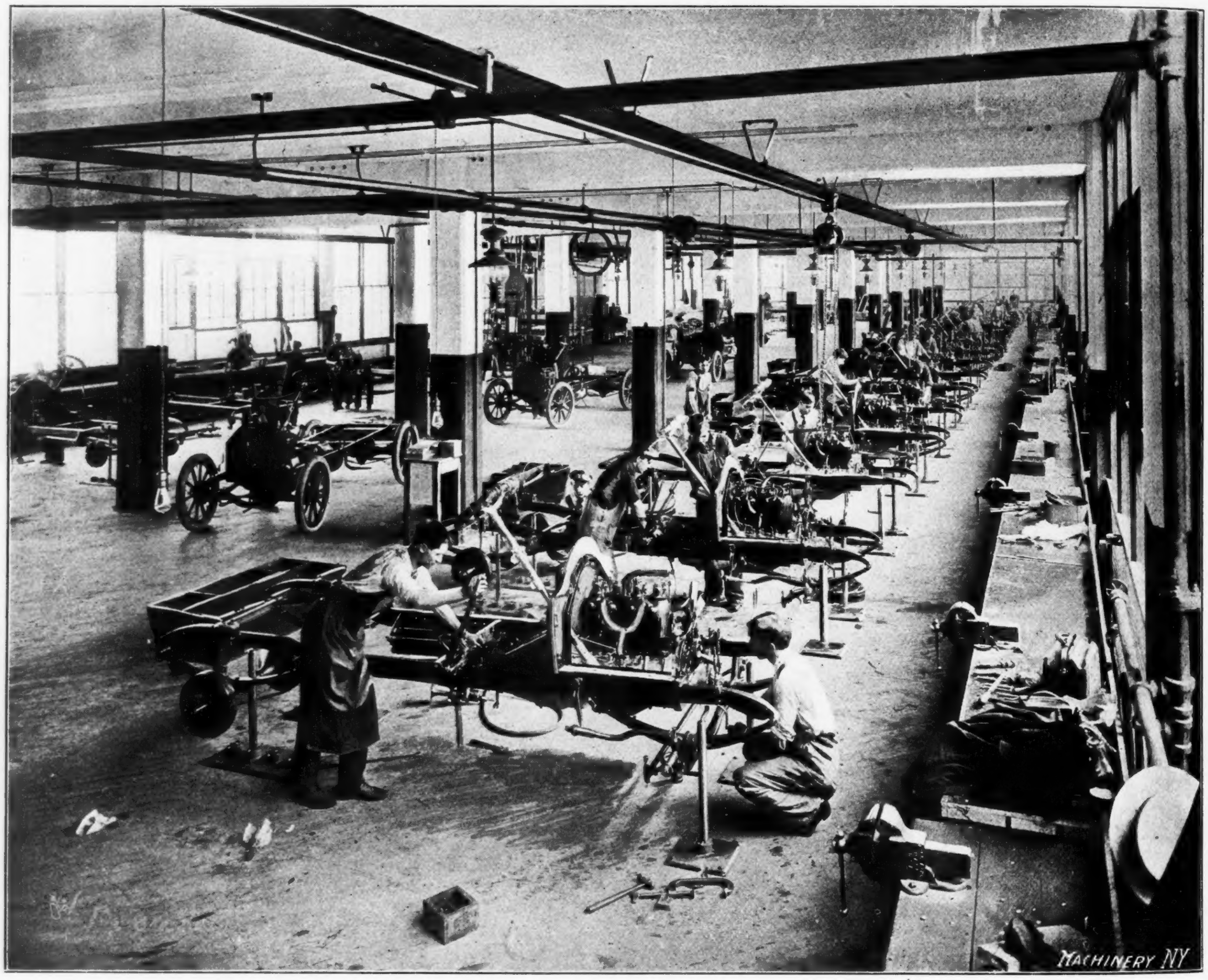


Fig 1. View of the Assembling Room, showing Arrangement of Overhead Track and Differential Hoists; the Trucks, each of which holds the Parts for Two Cars; and the Adjustable Frame Supports

The headquarters of the assembling department may be said to lie in the finished stock room, which occupies a large section of the floor of the main factory on which the assembling room proper is located. To this finished stock room come all finished parts such as nuts, bolts, screws, front axles, springs, and wheels, and the previously assembled motors.

* For further information on this subject, see "Machines and Tools for Automobile Manufacture," June, 1909, and articles there referred to.
† Address: Box 27, Times Square Station, New York.

transmissions, steering gears, and rear axles. These are all classified and placed by themselves, the smaller parts being kept in bins which extend in long rows down one end of the room. Lists pasted in conspicuous places along these bins show the exact number of each size and kind of bolts, nuts and other pieces required for the various models of cars made here, and hand trucks having bodies divided into compartments are drawn down past the bins and filled with the necessary number of small parts for two cars. In the larger divisions of the truck box or body are placed the axles, steering gear, running boards, foot rests, and other bulky parts of the car. Each truck is filled with a sufficient number of the

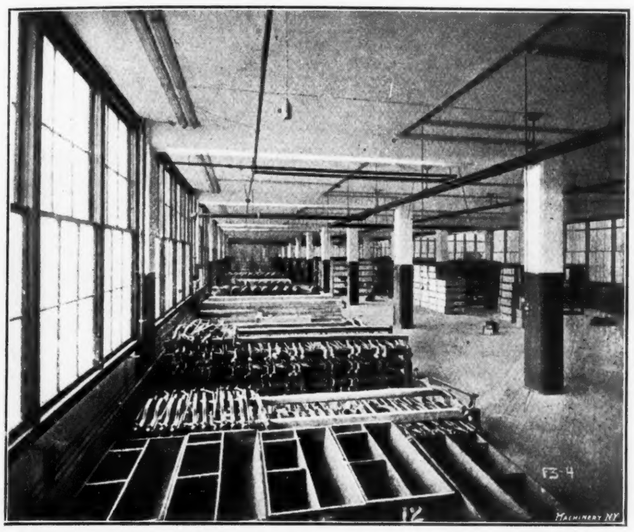


Fig. 2. View of Stock Room, showing Trucks in which Parts are taken to the Assembling Room, Assembled Parts, and Bins in which Smaller Parts are Stored

proper parts for the complete assembly of two cars and is then rolled into the assembling room, adjoining the stock room, and placed between two pressed steel frames which form the foundations, as it were, of the two chasses to be assembled. Having received the required number of parts of the proper kind, three men now devote their entire time to assembling the two chasses—and it is here that the advantages of "team work" are exhibited. Having become accustomed to this method of assembling, each man knows just what he is to do, and always has the other chassis at hand to which he can turn his attention when he is liable to interfere with the work of his two companions. It is highly specialized work, each team of three men devoting their whole time and energy to the installation and adjustment of the various parts of two cars until they are ready for the road test. As three men finish the first two chasses, another truck is brought in containing parts for two additional cars, and the team then devotes its attention to cars three and four. The motors are not included in the quota of parts comprising the truck load, but are carried in separately on differential hoists which travel on overhead tracks and pass in two lines down the sides of the assembling room in front of the two rows of chasses. When the frame is ready for the installation of its motor, the latter is lowered in place. This system renders each car independent of the stock room after the truck load of parts has been received, and the work bench, vise and kit of tools near every chassis reduce to a minimum the number of steps necessary to be taken by each workman.

The arrangement of the rests for holding the frames rigidly in place is very ingenious and entirely does away with the use of saw-horses or other movable and bulky supports. There are four of these supports for each frame, as shown in Fig. 1, and when not in use, one or all may be let down into the floor. Each of these supports consists merely of a vertical iron rod, bent at right angles at its upper end and forged into the shape of a hook. A corner of the frame rests on this horizontal portion of the rod, while the hooked-shaped ends of the two opposite supports prevent lateral motion in either direction. Each rod is supported by a pin passing through it at the proper distance from the end, which rests across the top of the base-plate which is bolted to the floor and through which the end of the rod passes. By giving a partial turn to the rod, the pin is allowed to pass through a slot in the base-plate, and the whole support is thus dropped until its top is flush with the floor. In order that the supports may accommodate themselves to various lengths of frames, the rear pair of every set of four base-plates is made with four sets of holes, in any of which the rods may be placed. The sets of supports are placed at such intervals along the floor that sufficient space between the frames is allowed to enable two teams of men to work on adjoining cars without interference. While it may seem a small matter, the facility with which these supports may be put in place, adjusted or removed from the floor, helps to make possible, in no uncertain degree, the record for the rapid assembly of cars of which this factory can boast.

Although not a part of the assembling room proper, the department in which the pressed-steel frames of channel-section are prepared for the chassis, has an important part in facilitating quick assembling. When the frames arrive at the factory, forty or fifty holes must be drilled for the various parts which are to be attached, such as the gear shift, brake levers and their supports, the motor, transmission, running boards, fenders, lamp brackets, springs, and the like. Most of these, with the exception of the motor and transmission, are riveted in place before the frames reach the assembling room. These operations are performed in the frame riveting room, which contains several unique and ingenious arrangements that, so far as efficiency is concerned, bring this department on a par with the assembling room. The frame is first placed on a set of supports similar to those used in the assembling room, except that a tension rod and turnbuckle connect both pair of rods for the purpose of holding the frame more rigidly in place. A single track over this set of supports carries a differential hoist, from which is suspended a large jig (see Fig. 3) containing a guide hole corresponding to every hole necessary to be drilled in the sub-frame, which carries the motor and transmission. This jig is clamped securely in place and the holes drilled by means of pneumatic drills connected to flexible piping. When all the

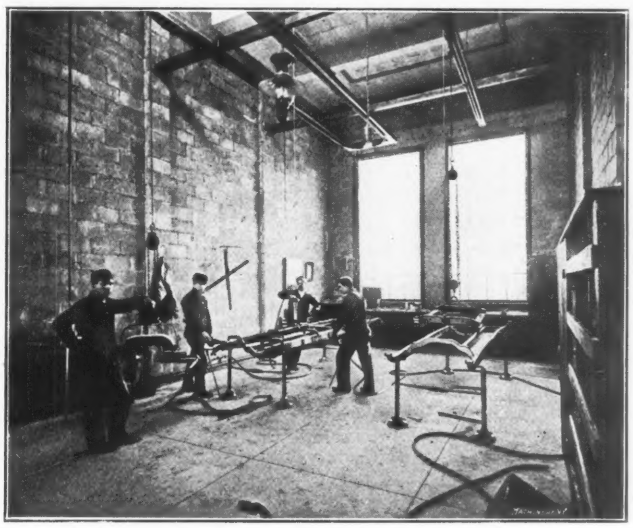


Fig. 3. Room in which the Frames are drilled and riveted by Pneumatic Tools

holes are drilled in this manner, the frame is removed to another set of supports a few feet distant where it is held rigidly in place in the same manner as that before described. Above this second set of supports is an oval track of the same length and width as the frame. From the traveler on this track is suspended a cable terminating in a single pulley through which passes a chain. On one end of this chain is a heavy, pneumatic riveter, which is counterbalanced by an iron weight attached to the other end of the chain. This enables the tool to be placed at any height desired without unnecessary exertion. A small forge (not shown in the illustration) in one corner of this room heats the rivets before they are driven into the frame. By means of the oval track and pulley, any vertical or horizontal plane bounded by the frame may be reached with the riveter, and four or five men

in this department are usually able to keep the assembling room supplied with the required number of frames. After being finished in this department, however, the frames in all cases are taken directly to the finished stock room, from which they are drawn out to the assembling room as needed. This stock room, in fact, acts as a sort of clearing house for the whole factory, and no part ever reaches the complete car until it has been inspected, checked and entered in the stock room records.

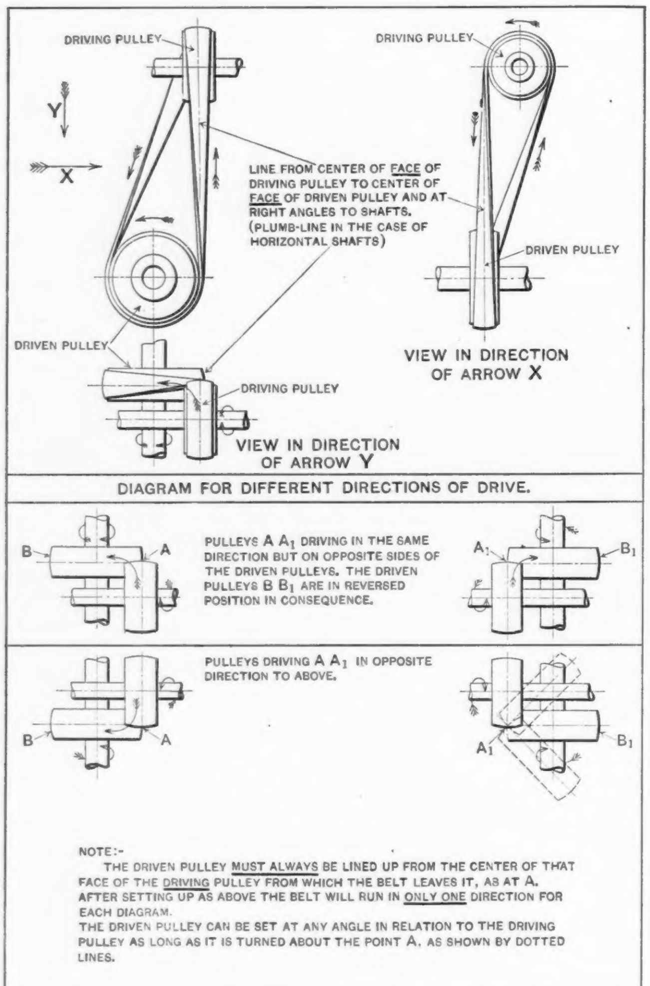
The keynote of this system is specialization. Every man knows what he has to do—and he does it. There is no overlapping of departments. It is scarcely ever necessary for the men in the assembling room to step into the stock room, and the men in the stock room are supposed to keep the men in the assembling department supplied with the necessary parts for the cars that have been ordered to be finished that day. Each team in the assembling room follows its two cars through until they are ready for the road test, and it is then easy to place the responsibility for any defect, where it belongs. When this system is supplemented with such labor and space saving devices as are used in the assembling and frame riveting rooms, and when, at the head of it all, is able, efficient and experienced management, one can begin to understand the conditions which allow the immense increase in production and the reduction in cost of the American-made motor car of today.

* * *

LOCATING ANGLE BELT DRIVES

GLASGOW

In answer to C. A. H.'s article in the August number, under the heading "What Would Jim Have Said," I submit herewith a data sheet of angular belt drives which was issued to



Locating Belt Drives when Shafts are not Parallel

the men here some twelve months ago. These diagrams show all the different positions of the pulleys for different directions of rotation of the shafts, and are also applicable to shafts in any position, vertical or horizontal.

ASSEMBLING MACHINE TOOL UNITS*

ALFRED SPANGENBERG†

In an article on "Elements of Assembling Operations" appearing in the September issue of MACHINERY, the writer laid down some fundamental principles relative to the methods and processes employed in manufacturing, and advanced the proposition that accurate drawings, accurate machine work and the use of jigs and gages are at the foundation of economical assembling. Interchangeability, standardization, and duplication in quantities were also discussed. The present

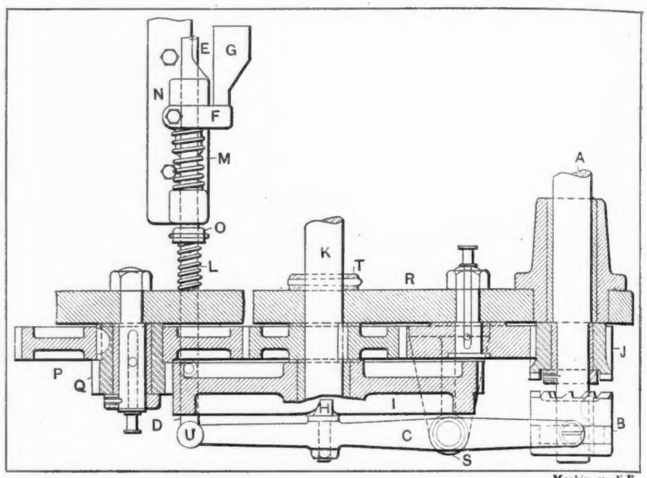


Fig. 1. Turret Lathe Indexing Mechanism to be assembled

article will deal with concrete examples illustrating the application of these principles in actual shop practice.

Assembling a Turret Lathe Indexing Mechanism

The turret lathe indexing mechanism shown in the line engraving Fig. 1 is presented to bring out clearly the necessity for analyzing the purpose of every part of a machine in order to machine and assemble the members so that they will function properly. In operation, the driving shaft *A* is constantly revolving in a certain direction. Keyed to this shaft is the sliding clutch member *B* operated by the forked lever *C*, link *D*, rod *E* and stop *F*. The dog *G* is bolted to the turret carriage and when the carriage is run back this dog strikes the stop *F*, thus withdrawing the indexing pin *H* from its slot in the index gear *I* and engaging the driven clutch member *J*. This starts the train of gears that revolves the turret by means of the worm shaft *K*, the worm-gear being bolted to the turret. An automatic knockout (not shown) stops the power traverse of the carriage the moment clutch *J* is engaged.

Fig. 2. Turret Lathe Indexing Mechanism shown in Detail in Fig. 1, Assembled

The turret continues to revolve until the carriage is run forward by throwing in the rapid power traverse mechanism which allows the indexing pin *H* to enter the slot in the index gear, and the turret stops revolving by virtue of the springs disengaging the clutch member *B*. The ratio of the back-gears is such that the index gear makes one revolution for each station on the turret. Spring *L* is for releasing the clutch and spring *M* keeps the stop *F* in position when the bracket *N* is moved along the bed in its T-slot. It is obvious that the springs should be as light as possible in order to avoid unnecessary wear on the indexing pin and face of the index gear and also to prevent a heavy pound when in

* For additional information on this subject, see MACHINERY, September, 1909, "Elements of Assembling Operations," and articles there referred to.

† Address: 951 W. Fifth St., Plainfield, N. J.

operation, but the springs must have sufficient power to always bring the index pin to the bottom of its slot in the index gear.

The length of the springs, their stiffness, and the position of the collar *O* on the rod are determined in the beginning by experiment, and when found to be correct, their dimensions are marked on the drawing so as to provide for standardization. To permit the use of light springs, it is absolutely essential that the clutch-operating members be fitted perfectly free so that the mechanism will index properly. The function of these members requires no rigidity in fit and the looseness desired is provided for by limits on the detail drawings, so that when the work, properly inspected, comes to the assembler no special fitting is required. As a general rule such parts receive little or no oil when the machine is in the hands of the operator, and if the parts are naturally stiff, trouble will arise. It must not be inferred that the writer is advocating such looseness in fits as to indicate poor workmanship, but many similar mechanisms have failed to work properly because of being too stiff, which shows lack of judgment and experience on the part of the assembler. The trouble in some cases, however, was due to the parts not being in proper alignment.

Before starting to describe any of the assembling operations, it will be well to bear in mind that while the description necessarily gives the operations in sequence, it is probable that in actual practice a number of different operations will be carried on at the same time, depending on the number of men working on the job. The gear plate and its cover, the latter being shown at *A*, Fig. 2, come to the assemblers

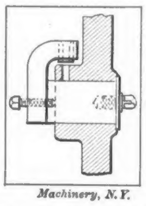


Fig. 4. Jig for Set-screw Holes

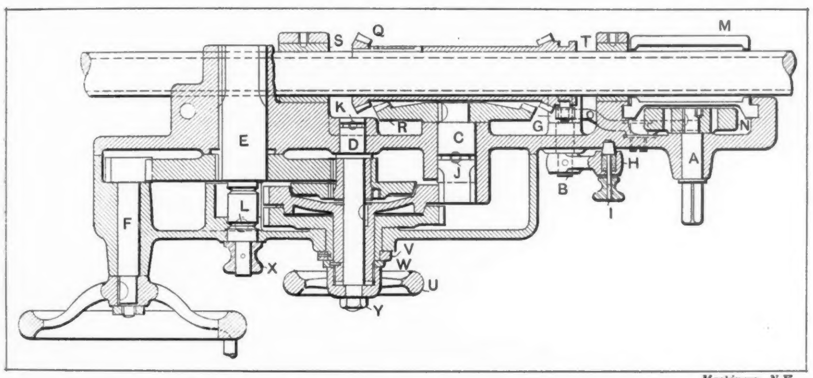


Fig. 3. Engine Lathe Apron to be assembled

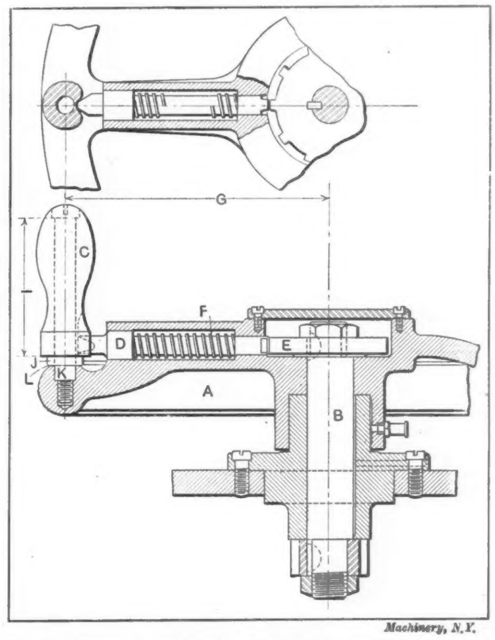


Fig. 5. Example of Device Difficult to assemble if Parts are not made in Jigs insuring Interchangeability

with all the holes jig drilled and reamed except the taper dowel pin holes *B*. All the oil grooves are machine cut except those for the worm-shaft in the gear plate and cover.

Assuming that the turret lathe beds are in process, the operations of assembling the mechanism complete will include bench and vise work and also floor work, since some of the members are interdependent with others on the lathe bed. The bench work consists of assembling the three independent groups, *viz:* the back gear members *P* and *Q*, Fig. 1; the fork lever members, including the sliding clutch *B;* and the operating rod bracket members *D, E, F, M, N,* and *O*.

The floor work consists of lining up the gear plate *R* on the lathe bed and assembling the entire mechanism. The operation of lining up is accomplished by means of two special arbors, one of which fits the worm-shaft bearings in the turret carriage and the other fits the holes in the operating rod bracket *N*, the arbors being long enough to pass through corresponding holes in the gear plate. The arbors are placed in position, with the turret carriage and operating rod bracket moved as close to the gear plate as possible, the latter now being bolted to the lathe bed. For obvious reasons the lining up is done with special reference to the operating rod and worm-shaft holes, since the adjacent bearing on the bed for the driving shaft *A* is some four feet away from that on the gear plate. Alignment of the driving shaft is tested by surface gage measurements taken from the top and side of the V on the bed, a few thousandths "off" being permissible.

Referring to Fig. 2, the bolt holes *C* have 1/32 inch clearance in the gear plate to allow it to be shifted slightly, and when properly set, the taper dowel pin holes are drilled in the bed by means of a pneumatic drill, then hand reamed, and the taper pins driven in place. The subsequent operations consist of assembling the shafts, studs and gears in their places, the process being so simple that no explanation is necessary. Next, the operating rod bracket members are put in place and then, after setting the index gear, the fork lever bracket *S* (Fig. 1), with its members already assembled, is bolted on and the connection with the link *D* made by inserting its pin.

Setting the index gear is accomplished in the following manner: The worm-shaft is set so that one-quarter of its total amount of back-lash is on the driving side, *i. e.*, if a line is placed on the periphery of collar *T*, and the total amount of backlash in the worm between its bearings in the turret carriage allows the line on this collar to travel ½ inch, then the worm-shaft is turned so that the line on collar *T* moves back ⅛ inch from the side towards which the shaft revolves when in operation. Now, with the fork lever members in place, excepting the pin *U*, the index gear is set so that when the indexing pin *H* is in position in its slot, the pin *U* will enter freely in its holes by virtue of their being in line.

The setting of the index gear to accomplish this is done by keeping the teeth of the index gear in mesh with its pinion and changing the teeth in the large back gear *P* in relation to those in its driving gear. Smaller adjustment of the index gear is obtained in this manner than by changing its teeth in relation to the teeth on the pinion *Q*, which fact is due to the ratio of the gears. Bolting on the cover is the final operation.

Assembling an Engine Lathe Apron

The engine lathe apron illustrated in the line engraving Fig. 3 is presented to show how machine tool units of this character are assembled on a manufacturing basis. Lathe makers, as a rule, build their lathe parts such as head-stocks, tail-stocks, rests and aprons in large lots so as to take advantage of the economy to be gained from carrying on the same operations on a large number of similar pieces in succession, both in machining and assembling; this has already been referred to.

It will be observed that the various shaft members are entirely independent of each other as far as their separate assembling is concerned, so that it is highly advisable to group these units to permit their being assembled at the bench as opportunity offers, which in most cases is while the aprons and covers are being bored and drilled. There are six distinct groups consisting, respectively, of the shafts *A* to *F* and their members. The assembling of these groups at the bench merely involves ordinary vise work so that little explanation is necessary. It will be well to state here that

when these parts are machined, particular attention is paid to the inspection of the length over shoulders, so that when the groups are assembled and put in place in the apron and cover no occasion will arise for any fitting or adjusting.

The method of testing shoulders on the friction gear shaft members, group *D*, in Fig. 3, is clearly shown at the right in Fig. 6; *A* represents a surface plate having a hole to receive the bearing end of the shaft. The double friction gear *B* when in its place in the apron has a lateral movement of 1/16 inch, the movement being controlled by the hand-wheel *C*. The dimension *D*, when all the friction surfaces are tight, being known, it is tested with a surface gage as indicated. The dimensions *E* and *F* are tested with ordinary length gages. A running fit is allowed on all shoulders while the length of the bearings in the apron and cover are made standard.

At the left in Fig. 6 is shown a jig for locating the levers *G* and *H* (Fig. 3) at the proper angle on their shaft while drilling and reaming the taper pin holes. This operation is done on a sensitive drill press to permit machine reaming.

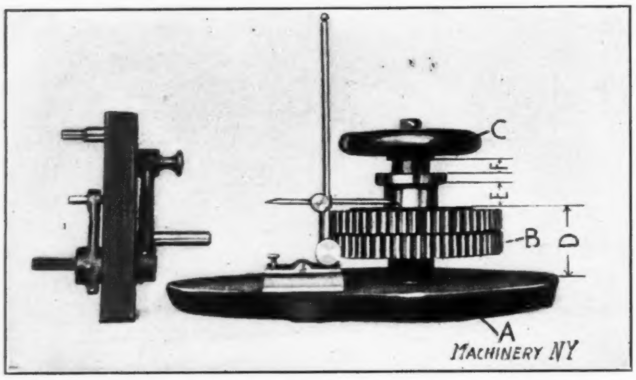


Fig. 6. Special Devices used in Assembling the Lathe Apron shown in Fig. 3

The jig is shown standing on end for the purpose of illustration, and its being used for two different sizes of levers accounts for the extra locating pins.

Referring now to Fig. 7, the method of testing the lead-screw nuts *M*, cam *N*, safety lever *O*, trunion lever *G* and the bevel gears *Q* and *R* is clearly indicated, the reference letters corresponding to those in Fig. 3. At *D* is shown a testing fixture in the form of an apron casting which is bored and reamed in the apron jig and is provided with supports at the back for holding it in the position shown. A short arbor representing the lead-screw is placed in the bearings *S* and *J* and holds the double bevel pinion *Q* (not in place in the engraving) in position.

It will be observed that the function of the safety lever is to prevent the double bevel pinion and the lead-screw nuts from accidentally becoming engaged at the same time, which

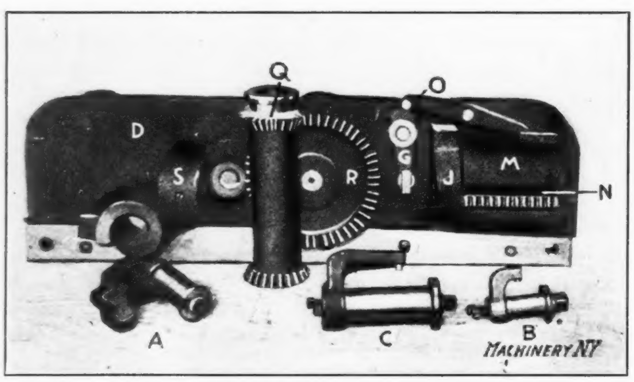


Fig. 7. Testing Fixture for Parts of Lathe Apron

would cause a breakage. Special milling fixtures are provided for milling the ends of the safety lever and the slot in cam *N* and lever *G*.

A babbitting jig is provided for the lead-screw nuts so that it is not necessary to babbitt them in place on a threaded arbor. The cam pin holes in the nuts are jig drilled. This has the advantage of making the nuts interchangeable besides avoiding the necessity for carrying hot babbitt any distance through the shop. If any of the members fail to function properly, the faulty member is, of course, replaced.

All the drilling, boring, and machine reaming on the aprons and covers is completed in the drilling department except the holes for the oil pipe (not shown) spring pin *I* and set-screws *J* and *K* (Fig. 3). Small holes such as these can be

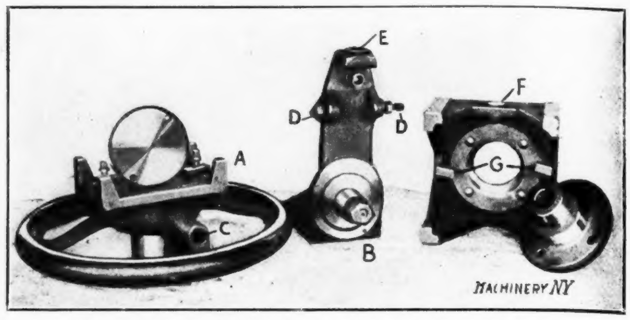


Fig. 8. Jigs for Drilling Parts of Device shown in Fig. 5

drilled cheaper with an air drill, due to the fact that the oil holes are comparatively short and are on an angle, while the spring pin hole *I* cannot be drilled until some of the assembling operations are completed.

When the aprons and covers are received in the assembling department, they are placed on special trestles for convenience in assembling. The castings are now painted, all of the chipping and cleaning having been done in the foundry. The next operation consists in drilling the oil holes and the holes for the set-screws *J* and *K*. Jigs for drilling the latter are shown at *A* and *B* in Fig. 7. Jig *C* drills the spring pin hole *L* in the apron cover which is machine drilled. The hole is at right angles to the top of the cover and the jig is easily set up as is evident by referring to Fig. 4 which shows jig *B* in position in the apron. It will be observed that these jigs permit the groove in the shafts to be cut standard size and the shafts made interchangeable.

After chipping the oil grooves and tapping the screw holes, the covers are bolted on for the purpose of hand reaming

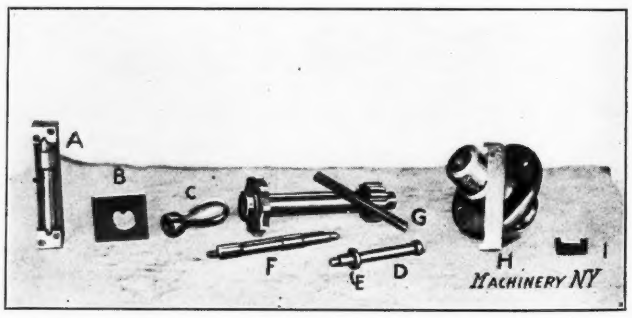


Fig. 9. Gages for Testing the Parts of the Device shown in Fig. 5

all shaft holes to standard size. The covers are then removed and the aprons laid face down for the purpose of fitting the lead-screw nuts *M* (Figs. 3 and 7). The nuts, babbitting jig and grinding ways in the apron being machined to gage, it is only necessary to smooth the surfaces on the nuts and apron to make the nuts slide freely.

When all of the members shown in Fig. 7 fitting the back of the apron have been fitted and tested at the bench, they are put in place in the aprons. In performing this operation the corresponding pieces are placed in each apron in succession. With the lead-screw nuts closed by means of the cam, a special tap, mounted on an arbor fitting the lead-screw bearings, is run through the nuts to clean out the threads.

The aprons are now turned face up for the purpose of fitting the oil pipes and drilling the holes for spring pin *I* (Fig. 3). There are three holes to be drilled in the apron for this pin to enter, one for the central position of lever *H* which operates the double bevel pinion, and one for each extreme position. A special center punch which fits the hole in lever *H* is used to lay out these. The central position is determined by the safety lever fitting into the notch in lever *G*; while the bevel pinion mounted on an arbor and alternately brought into mesh with the bevel gear, determines the extreme positions. After the holes are drilled by means

of a pneumatic drill, a reamer is substituted for the center punch in lever *H* and the holes reamed taper to fit the spring pin *I*. A collar on the reamer acts as a depth gage. It would, of course, be possible to drill these holes in the jig that drills and bores the aprons, but this is hardly deemed advisable as there are a number of elements that must be taken into consideration, an error in any one of which would prevent the bevel gears from meshing properly. Placing the spring pins *I* in position completes the work on the feed reversing mechanism.

The rack pinions *E* and gears are now put in place, then the friction gear shafts *D* and their members, except the hand-wheel *U* and collars *V* and *W*. After driving in the studs for the intermediate cross-feed gears (not shown because of the sectional view) the aprons are ready to receive the covers.

Work on the covers consists in placing the hand-wheel pinions and hand-wheel members in position and fitting the rack pinion spring pin members after which the covers are bolted onto the aprons. The rack pinion knob *X* is now put on and then the collars *V* and *W* are fastened onto the friction gears as shown in the line engraving Fig. 3. Screwing on the hand-wheel *U* and nut *Y* completes the apron and it is ready to be sent to the store room.

Assembling an Automatically-releasing Hand-wheel Mechanism

Unless jigs and gages are used in the machining process, the peculiar conditions encountered in assembling a mechanism such as shown in the line engraving Fig. 5 would call for a high degree of skill on the part of the assembler besides involving excessive cost. The half-tones Figs. 8 and 9 illustrate a set of jigs and gages for producing this mechanism, which enables the assembling to be done without any filing or fitting, the object being to illustrate that *interchangeable* manufacture is really *economical* manufacture.

It will be seen that the function of the device is to automatically engage and disengage the hand-wheel member *A* with its shaft *B*, the action being as follows: Turning the hand-wheel in either direction by means of the handle *C*, so that the latter does not rotate in the hand, engages the pawl *D* with the ratchet *E* which is keyed to the shaft *B*; on releasing the handle, spring *F* disengages the pawl.

The requirements are that the handle and pawl must work perfectly free so that no effort to grip the handle hard will be necessary; the axis of the handle and pawl must intersect so that each cam face will work equally well; when the pawl is fully engaged with the ratchet, the handle end of the pawl must still be on the cam face of the handle; the contour of the cam, length of the pawl, diameter of ratchet and center distance *G* must be within close limits. Referring to Fig. 8, *A* is a jig for drilling the hand-wheel cover and its screw holes in the hand-wheel. The jig is shown in position for drilling the latter, being located in the counterbore of the hand-wheel. Resting on top of the jig is the hand-wheel cover which fits into the recess shown and is held by the two straps and bolts. The hand-wheel and its cover are, of course, drilled separately.

At *B*, in the same figure, is shown a jig for drilling the handle stud hole and the pawl hole *C*. The hand-wheel is located on a stud through its bore, and clamped to the jig by passing a bolt through the stud, this bolt being provided with a split washer on the end. To bring the pawl hole central with its hub, two set-screws are provided at *D* which hold the hand-wheel in position while being drilled by clamping against the sides of the spoke. The jig is fastened on the edge of the drill press table, so that the table does not interfere with the wheel. The vertical hole, with the drill guided by bushing *E*, is now drilled and reamed in all the hand-wheels, this hole being the pawl hole. For drilling and reaming the small diameter, a long bushing is used in the large diameter of the hole to guide the tools. When this hole is drilled, the jig is then clamped to the side of the box table and the hole for the handle stud is drilled in all the wheels.

The jig shown at *F* in the same engraving is for drilling the shaft bearing which is seen to the right. The hub on the bearing fits into the jig, the straps *G* holding the work in place. Both this jig and the one at *A* are provided with complete sets of clearance and tap bushings so as to permit their being used on a multiple spindle drilling machine.

In Fig. 9 will be seen a set of gages for testing the component parts of the mechanism shown in Fig. 5. Gage *A* is for testing the length of the pawl which is shown in position in the gage. The ends of the pawl are milled with forming cutters. At *B* is shown a gage for testing the cam surface on the handle *C*. This cam is also milled with a forming cutter and when milled to the proper depth will just pass through the gage. The gage *D* is used to test the handle for length *I* (Fig. 5), the collar *J*, the depth of counterbore *K*. This gage represents a standard handle stud except that it is provided with a groove to fit the U-shaped collar *E* which is of the same diameter and thickness as the collar *J* in Fig. 5. To test the handle, the gage is inserted into the hole and the U-collars slipped into the groove; the collar *J* is tested for thickness by fitting the groove in the gage; to test the depth of the counterbore *K*, the gage is screwed into the hand-wheel and the collar *E* tried as before.

The tool shown at *F* is the counterbore used in connection with jig *B*, Fig. 8, for finishing the counterbore *K* and surface *L* in Fig. 5. At *G*, Fig. 9, is a length gage for the shoulders on the hand-wheel shaft against which the gage is seen resting. In the same engraving, *H* is a gage for testing the length through the bearing hole, while to the extreme right at *I* is shown a length gage for the hand-wheel shaft hole.

It will be observed that all of these gages, with one exception, that of the cam gage *B*, are length gages. Their use was found imperative for interchangeable work. This is due to the fact that errors in length are far more likely to occur and cause trouble in assembling than errors in diameter. All of the essential measurements of diameter on the component parts of the mechanism shown in Fig. 5, *i. e.*, the running and driving fits, are tested with ordinary limit and plug gages, while the threaded members are tested with male and female thread gages.

In assembling the mechanism, the pawl, its spring, and the handle members are first assembled. After fitting the Woodruff keys and the shaft members, the ratchet wheel is removed for the purpose of assembling the bearing and hand-wheel. The ratchet wheel is then replaced and the nut screwed down tightly with a socket wrench, the shaft being held from turning by engaging the pawl. Fastening on the cover and screwing in the oil cup finish the assembling operations. There is no adjusting or fitting to be done since the proper allowances for all fits are provided for on the detail drawings and the accuracy of the machine work is insured by a thorough system of inspection. Thus it will be seen that the work of assembling in this case merely consists in combining the separate elements in their logical order.

Summary of Principles of Assembling Operations

Summarizing the principles referred to in the previous discussion, we may state the following rules as being the main points to be considered in assembling work.

1. To secure economical results we must have accurate drawings, accurate machine work, and use jigs and gages.
2. The use of limits on detail drawings is valuable especially when supplemented with a thorough system of inspection.
3. Inspection, both in the machine and assembling departments, is absolutely necessary.
4. Before assembling any part of a machine, its function should be thoroughly understood in order to have the parts work properly and to avoid any unnecessary refinement.
5. Study carefully the question of rigidity in fits.
6. Plan quick and efficient methods of lining up.
7. Always follow the drawings. In no case should deviations be permitted.
8. Anticipate any extra chipping for clearance that may be necessary, and so avoid having to take the work apart.
9. Analyze the elements carefully, and see if it will not pay to substitute the machining process on pieces that are sometimes fitted by hand.
10. Standardization is one of the cardinal princples of economical assembling. Therefore, do not leave stock for adjustment when the pieces can be machined to standard size.

11. Provide for the duplication of parts in quantities so as to take advantage of the saving to be gained from performing the same operation on a number of pieces in succession.

12. Separate the assembling operations for any particular job so as to provide for a subdivision of labor.

13. Follow the unit system of assembling in order to permit a large number of workmen to be employed on a job.

14. The operations involved in assembling the units should be separated from the erecting process.

15. All chipping should be done before the parts are scraped.

16. Where it would be necessary to take the work apart to line up the brackets or bearings, perform the lining-up operation first.

17. Plan methods and processes so that the work can be assembled with the least amount of handling.

18. Provide ample handling facilities.

19. Make the laborious operations in scraping as easy as possible by providing efficient pulling devices.

20. Before sending the units to store or to the erectors see that the operations are completed as far as possible.

* * *

FORMULAS FOR CONE CLUTCHES*

There appears to be considerable misunderstanding, or perhaps rather, lack of understanding, of the formulas for cone clutches. A number of formulas are given in various handbooks and treatises on design, but at first sight they do not agree, and if the designer has not deduced any of the formulas for himself, he will naturally doubt the source from which he obtains them because of finding discrepancy between final results. However, the various authorities in general give correct formulas, and the difficulty met is caused by the fact that in cone clutch design different formulas are developed according to whether the clutch surfaces are considered to engage with or without some slip. In the following a set of formulas are deduced for both conditions, and a summary of these formulas is given in the accompanying Data Sheet Supplement:

Assume that:

H.P. = horse-power transmitted,

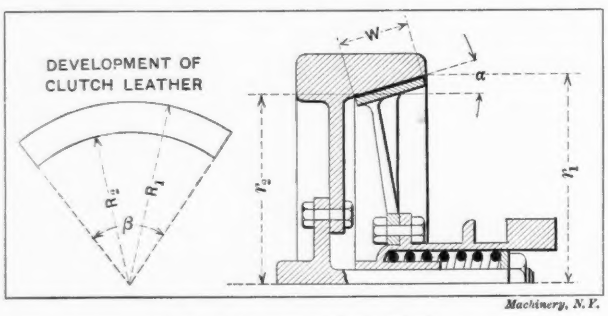


Fig. 1. Diagram of Cone Clutch

N = revolutions of crank-shaft per minute,
r = mean radius of friction cone, in inches,
r_1 = large radius of friction cone, in inches,
r_2 = small radius of friction cone, in inches,
R_1 = outside radius of leather band, in inches,
R_2 = inside radius of leather band, in inches,
v = velocity of a point at distance r from the center, in feet per minute,
F = tangential force acting at radius r, in pounds,
P_n = total normal pressure between cone surfaces, in pounds.
P_s = spring pressure, in pounds,
α = angle of clutch surface with axis of shaft = 7 to 13 degrees,
β = included angle of clutch leather, when developed,
f = coefficient of friction = 0.20 to 0.25 for greasy leather on iron,
p = allowable pressure per square inch of leather band = 7 to 8 pounds,
W = width of clutch leather, in inches.

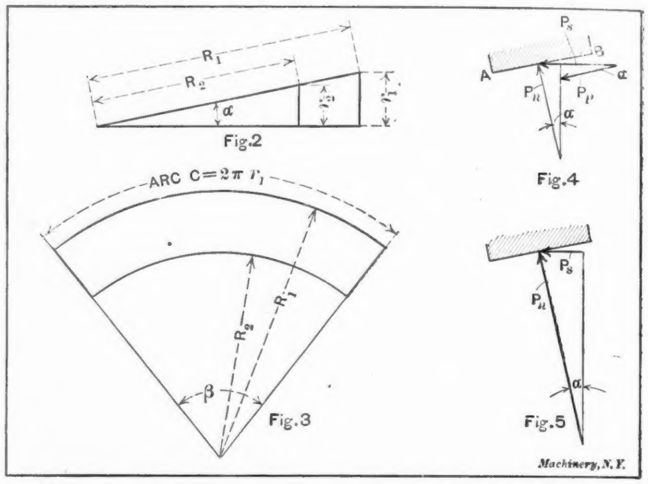
* With Data Sheet Supplement.

The relation between the outside and inside radii R_1 and R_2 of the clutch leather for covering the friction surface and the radii r_1 and r_2 of the friction cone are expressed by the following formulas, the deduction of which are clearly seen from Fig. 2.

$$R_1 = \frac{r_1}{\sin \alpha}$$

$$R_2 = \frac{r_2}{\sin \alpha}$$

The included angle β of the developed clutch leather (see Fig. 3) is found as follows: The length of the outside arc of the developed clutch leather surface equals the largest circumference of the cone clutch, or arc $C = 2\pi r_1$. (See Figs.



Figs. 2 to 5. Diagrams for Deducing Formulas for Cone Clutches

1 and 3.) Angle β is to 360 degrees as arc C is to the whole circumference of the circle having R_1 for radius. Therefore,

$$\frac{\beta}{360} = \frac{2\pi r_1}{2\pi R_1} = \frac{r_1}{R_1}.$$

But it has already been shown that $R_1 = \frac{r_1}{\sin \alpha}$, or $r_1 = R_1 \times \sin \alpha$, and therefore

$$\frac{\beta}{360} = \frac{R_1 \times \sin \alpha}{R_1} = \sin \alpha, \text{ or } \beta = \sin \alpha \times 360.$$

It is obvious that the mean radius r of the friction cone equals the arithmetic mean of the largest and smallest cone radii, or

$$r = \frac{r_1 + r_2}{2}$$

The velocity v of a point on the friction cone at a distance r from the center is found by the well-known formula

$$v = 2\pi r N$$

in which v and r are supposed to be measured in the same units. If v is in feet, and r in inches, the formula takes the form

$$v = \frac{2\pi r N}{12}$$

The tangential force acting at radius r, in pounds, is found by the formula

$$F = \frac{\text{H.P.} \times 33{,}000}{v}$$

which is deduced directly from the familiar formula for horse-power when the torque is given in foot-pounds.

If the width of the clutch surface is W, the area of this surface is $W \times 2\pi r$. The total pressure on the surface, P_n, must equal the pressure per square inch multiplied by the area, or

$$P_n = W \times 2\pi r p.$$

From this we deduce the formula

$$W = \frac{P_n}{2\pi r p}.$$

The horse-power transmitted equals

$$\text{H.P.} = \frac{P_n f \times 2\pi r \times N}{12 \times 33{,}000}$$

in which r is given in inches. By inserting the value of π in this formula, and dividing numerator and denominator in the fraction by 2π, we get

$$\text{H.P.} = \frac{P_n f r N}{63{,}025}$$

In Fig. 4 let it be assumed that the clutch surfaces engage without slip. Assume further that the spring pressure is represented by line P_s, the pressure normal to the clutch surface $A\,B$ by P_n, and the force tending to bring the clutch surfaces in closer engagement by P_p; this last force, of course, is parallel to $A\,B$. The force P_s is partly used for producing the normal pressure P_n and partly used for bringing the clutch surfaces in closer contact; consequently

$P_s = P_n \times \sin a + P_p \times \cos a.$

But $P_p = P_n \times f.$

Therefore

$P_s = P_n (\sin a + f \cos a)$

$$\text{and } P_n = \frac{P_s}{\sin a + f \cos a}$$

If we substitute this value of P_n in the horse-power formula just deduced, we have

$$\text{H.P.} = \frac{P_s f r N}{63{,}025\ (\sin a + f \cos a)}$$

Transposing, we get

$$P_s = \frac{\text{H.P.} \times 63{,}025\ (\sin a + f \cos a)}{f r N}$$

If we assume that there is some slip between the clutch surfaces, the force P_p in Fig. 4 becomes zero, and the whole of force P_s is used to produce normal pressure, as shown in Fig. 5. Then

$$P_n = \frac{P_s}{\sin a}$$

and, substituting in the horse-power formula, as before, we have

$$\text{H.P.} = \frac{P_s f r N}{63{,}025 \sin a}$$

and

$$P_s = \frac{\text{H.P.} \times 63{,}025 \sin a}{f r N}$$

The most important of these formulas have been collected in compact form and are given without their deductions in the Data Sheet Supplement. They will be found very convenient for ready reference when designing cone clutches or checking designs already made.

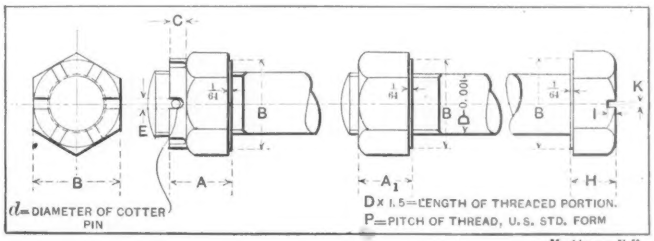
* * *

The export of automobiles from France, which declined in 1908, has shown a slight increase during the first months of 1909. During the first three months of the year 1907 France exported automobiles valued at approximately \$10,300,000. During the first three months of 1908 the exports declined so that the total value of automobiles exported was only \$8,700,000. During the first three months of the current year the exports again rose to \$9,500,000. England is the best customer of France for automobiles, more than forty per cent of the exports being to Great Britain. The exports of automobiles to the United States are decreasing so that during the first three months of 1909 automobiles to a value of only slightly more than \$500,000 were imported, as compared with over \$800,000 in 1908, and nearly \$800,000 in 1907. The Argentine Republic appears to offer a good field for the automobile trade, the French exports to that country during the first three montns of the current year amounting to over \$750 000. The imports of automobiles to France are almost negligible when compared with the exports. During the first three months in 1909 the total value of imported automobiles amounted to about \$400,000, the United States supplying cars to a value of only \$16,000. Germany and Italy supply the largest proportion of cars imported by France.

STANDARD AUTOMOBILE PARTS ADOPTED BY THE A. L. A. M.*

The Association of Licensed Automobile Manufacturers (A. L. A. M.) has, from time to time, standardized some parts which occur in automobile design, and which are likely to require frequent replacement or repairs. The most important of the standards adopted by the association undoubtedly are the standards for fine pitch threads, screws, castle and plain nuts, which were published in MACHINERY'S Data Sheet No. 63, accompanying the November, 1906, issue. In this issue an editorial was also published entitled "Automobile Fine Screw Threads" in which the new standard for screw threads was discussed. A table condensed from the Data Sheet mentioned, giving all the required dimensions, is published herewith.

STANDARD HEXAGON-HEAD SCREWS, CASTLE AND PLAIN NUTS



Machinery, N.Y.

D	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	1
P	28	24	24	20	20	18	18	16	16	14	14
A	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{13}{32}$	$\frac{29}{64}$	$\frac{9}{16}$	$\frac{39}{64}$	$\frac{23}{32}$	$\frac{49}{64}$	$\frac{13}{16}$	$\frac{29}{32}$	1
A_1	$\frac{7}{32}$	$\frac{17}{64}$	$\frac{21}{64}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{31}{64}$	$\frac{35}{64}$	$\frac{19}{32}$	$\frac{21}{32}$	$\frac{49}{64}$	$\frac{7}{8}$
B	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{7}{16}$
C	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
E	$\frac{5}{64}$	$\frac{5}{64}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$	$\frac{5}{32}$
H	$\frac{3}{16}$	$\frac{15}{64}$	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{3}{8}$	$\frac{27}{64}$	$\frac{15}{32}$	$\frac{33}{64}$	$\frac{9}{16}$	$\frac{21}{32}$	$\frac{3}{4}$
I	$\frac{3}{32}$	$\frac{7}{64}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
K	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$
d	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

Since the adoption of the standard A. L. A. M. thread, the association has adopted a standard spark plug, the dimensions and special specifications of which are given in the accompanying supplement. Standard designs for adjustable and solid yoke and eye rod ends have also been adopted, dimensions for which are also given in the supplement, together with dimensions for the pins and washers used with these rods.

The horse-power of automobile engines has always been more or less indefinitely expressed, and until recently there has been no formula giving a satisfactory relation between the horse-power and the diameter of the engine cylinder and the piston speed. The association, therefore, some time ago adopted a standard horse-power formula, assuming a piston speed of 1,000 feet per minute. According to this formula, if

D = diameter of cylinder, and

N = number of cylinders,

$$\text{then H.P.} = \frac{D^2 \times N}{2.5}.$$

The table in the supplement giving horse-power of automobile engines has been calculated from this formula for engines having one, two, four and six cylinders, with the diameter of the cylinder varying from 2½ to 6 inches. It will be understood, of course, that this formula gives only approximate results, as the actual horse-power of any one automobile engine could not be expressed by so simple or general a formula. However, this formula is of great assistance in estimating in a general way the probable horse-power of an automobile engine.

* * *

A commission has been at work for the last two years in Sweden preparing a new schedule for import duties. The new tariff, which has not yet been adopted, proposes increases in the import duties imposed on machinery, the avowed purpose being to protect home industries.

* With Data Sheet Supplement.

TREATMENT OF GEARS FOR AUTOMOBILE MOTORS AND TRANSMISSIONS

HAROLD WHITING SLAUSON*

There is probably no part of an automobile that is subjected to more use or greater abuse than the transmission. Carrying as it does practically all of the power developed by the motor, and, receiving at the hands of a careless driver the strains imparted by a suddenly applied load or a too rapid shifting of the speeds, it is small wonder that the gears of the transmission must be made of the highest grade of materials, and that the care and workmanship bestowed upon each must be of the best. The ordinary automobile transmission consists of a series of different sizes of spur gears mounted on two parallel shafts with means for sliding the gears on one shaft into mesh with those on the other, as desired. In this manner various speed ratios are transmitted from the motor to the main driving shaft, although on the majority of automobiles the high speed drives the car direct, without the interposition of any of the gears of the transmission.

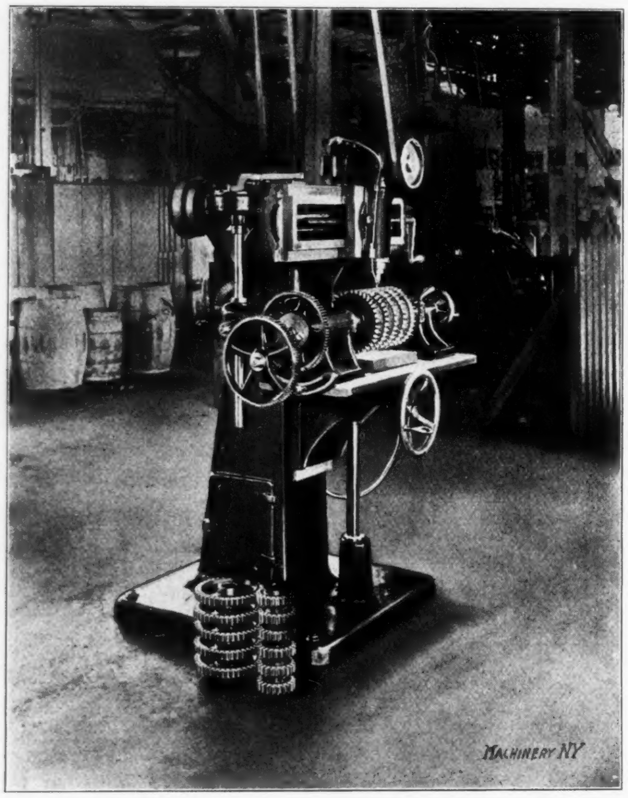


Fig. 1. Chamfering the Teeth of Spur Gears in the Winton Factory

As a saving in weight is an important factor to be considered in the design of a transmission, the gears must be made as small as possible and yet be sufficiently strong to carry suddenly-applied loads with no attendant danger of breaking. Owing to the methods by which the speeds are changed, and the clashing and "bruising" which take place when the gears are shifted, the transmission must also be made of a material which is hard as well as tough. Different kinds of steel have been used and each has been treated by various methods in an effort to discover the perfect gear material, but although this is yet to be found, the transmission of a modern, well-made automobile, when intelligently handled, will last nearly as long as the car itself. Of the various kinds of carbon steel which have been employed for transmission gears, nickel, chrome-nickel and silico-manganese seem to have more adherents among the leading builders than any other materials. In most factories the gears are case-hardened after being cut, and in this manner the combination of toughness with the desired hard surface is obtained. Gears which have been treated in this way have been taken out of cars after having been run many thousands of miles, and in some instances, the original tool marks on the faces of the teeth were still visible.

* Address: Box 27, Times Square Station, New York.

Methods employed for cutting gears in automobile factories do not differ in any essential features from those used in any well-equipped machine shop or manufacturing concern. Most of the automobile makers purchase their transmission gear blanks outside and cut and finish them in the factory. Many of these blanks of special steel are imported from France, but a few of the leading factories have laboratories of their own in which experiments on high-quality materials for transmission purposes are continually in progress. Six or seven spur gear blanks of the same size are generally placed on the mandrel of the cutter at once. A continuous cut extending throughout the width of all of these blanks is then taken for each tooth, and in this manner six or seven gears are finished at once and are made absolutely uniform.

After the teeth have been cut, the gears are taken to the heat treating room to be case-hardened. In the Middle West, and a few other sections, many of the case-hardening ovens are heated by natural gas obtained from near-by wells. In the Maxwell factory, at Newcastle, Ind., a special machine has been installed for the manufacture of gas from "distillate"—a hydro-carbon obtained from the oil refineries. This machine is set up in the power house connected with the factory, and the gas is stored in a tank located in the same building. It is conducted from here to the heat-treating ovens in which it is used for case-hardening, tempering and annealing. Still another method for obtaining heat for the ovens is in use at the Ford factory, in Detroit. Petroleum, or crude oil, is vaporized and forced by air pressure into a series of special burners located under the ovens. By regulating the amount of air or vapor or both, the ovens can be kept at a uniform temperature, or the amount of heat generated may be varied at will between almost any limits. The temperatures of the ovens are indicated by an electric pyrometer connected with each, and pieces to be case-hardened are kept at a heat of 1,600 degrees F. for a length of time which depends on the depth below the surface to which it is desired to carry the treatment.

In several factories the final operation bestowed upon the gear, before assembly in the transmission or the motor, is the sand blast which serves to scour off any roughness or stains which may have been left on the surface during the cutting or the heat treatment. In the National factory, at Indianapolis, this operation is conducted in a small building separated from the remainder of the shop. The sand is kept in a bin in one corner and is sucked up by a centrifugal blower and forced by the air pressure through a pipe which terminates in a nozzle. The sand, being forced out at high velocity by the air pressure, may be directed at all parts of the pieces to be cleaned. This is one of the most efficient methods of polishing and finishing a gear and does not injure the hard metal surface in any way.

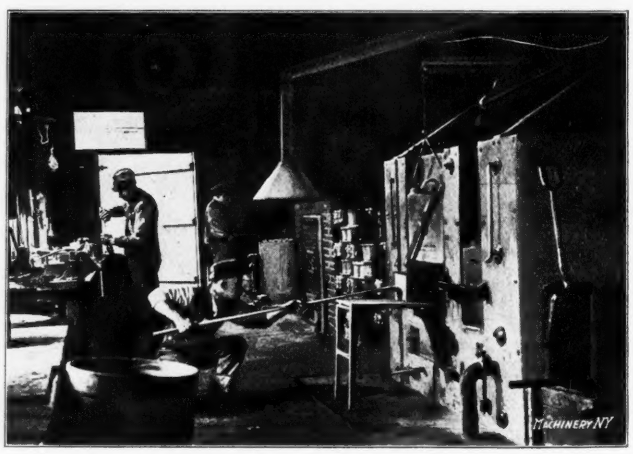


Fig 2. Gear Case-hardening Room in the Premier Factory

As silence of operation of all moving parts is one of the principal requisites for a motor car of to-day, it is necessary that the teeth of all gears shall be made to mesh perfectly and smoothly with all of those on the other gears with which they come in contact. In order to obtain silence of operation, the gears are run with each other for some time and each tooth is worn to a more perfect fit. The first few weeks of

operation by the customer would wear the gears in properly, but, in order to produce a perfect car, this is done before it leaves the factory. Most of this "running in" of the gears can be accomplished by the thorough road test to which the whole car is subjected before leaving the shop, but many of the leading factories supplement this with additional methods for bestowing the required wear on the transmission. A special frame is used in the Marmon factory, in Indianapolis (see Fig. 3), in which the transmission, driving shaft, differential, and rear axle and wheels are set up. An

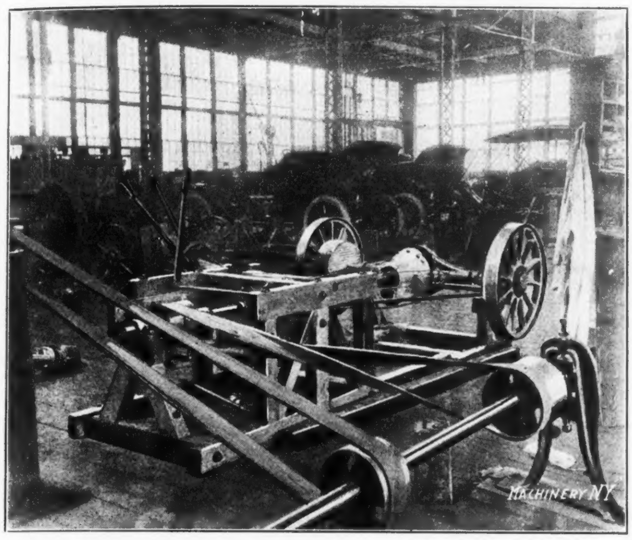


Fig. 3. Running in the Transmission and Differential Gears in the Marmon Factory

idler and a driving pulley, with a belt shifter, are attached to the front end of the transmission shaft and connected by belt to a countershaft driven from the main line shafting. When the power is applied and the different speeds of the transmission are thrown into mesh by the shifting lever, every gear of the whole car, with the exception of those used on the motor, will be set in motion. The gears of the engine are worn in when it is operated under belt power before installation in the chassis. Somewhat the same method is pursued in the Packard factory, in Detroit, the only difference between the two being that here, instead of allowing the wheels to run free, a brake is attached to the end of the driving shaft by means of which a variable load may be applied to the gears in mesh. A section of the testing room is devoted to this purpose, and as the transmission and rear axle are assembled, they are brought in, placed on special

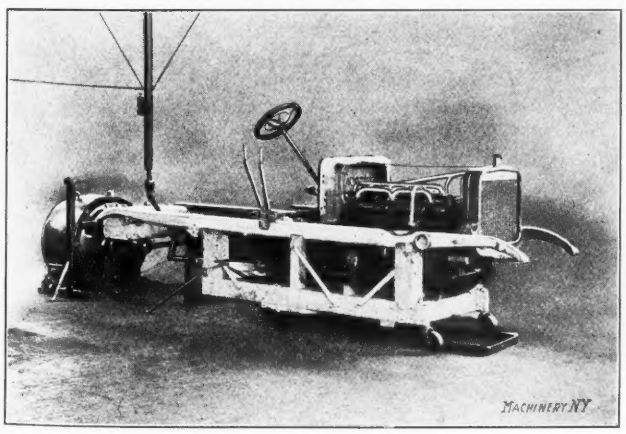


Fig. 4. Preliminary Run of Engine and Transmission to wear in the Parts

frames provided for the purpose and connected by belts to overhead shaftings. As the gears of the transmission and differential are run in, the loads are increased until all are worn perfectly smooth.

Before their final installation in the motor and transmission, all of the spur gears for the Winton cars, made in Cleveland, are set up in a special case and run in under belt power. The bearings in these special cases are set at the proper distances apart to accommodate the various gears of a train, thus wearing in the gears so that all of those for similar parts are absolutely interchangeable. The case is made oil-tight and a mixture of finely powdered emery and lubricating oil is fed through an opening in the top so that this grinding material will come in contact with all the teeth of the gears in mesh in the train. This grinding is continued until each tooth has been worn perfectly smooth and to an accurate fit with the teeth of the other gears with which it comes in mesh. For the gears used in the front of the motor to drive the cam, pump and magneto shafts—gears which always occupy the same relative position in regard to each other—a tooth of each is marked when in the grinding case with the corresponding teeth of the others with which it meshes. This is done so that each gear of the train may be set up in the motor in the same corresponding position as that occupied while being worn to a perfect fit with the others in the case. It is evident that every tooth cannot be of *exactly* the same size and shape, and if each tooth is allowed to mesh with those with which it came in contact while being ground, more perfect rolling contact will take place and less friction and noise will be set up. The marks made on the gears are also useful for timing the magneto and valve cam shafts when the occasion arises necessitating the removal of any of these parts from the motor. Of course, it is impossible to carry this practice to the transmission, for most of the gears on one shaft revolve independently of those on the other, and it is very seldom that the same teeth of two gears will come into mesh on succeeding occasions. This practice, however, may be applied to the bevel gears of the driving shaft and rear axle and the pinions of the differential. As a further means of wearing the gears of the transmission to a perfect fit, the motor, transmission and driving shaft are installed in the chassis as

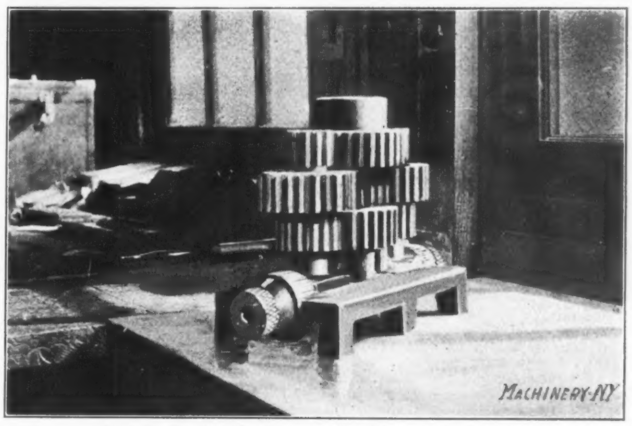


Fig. 5. Device for Testing the Accuracy of Gears

shown in Fig. 4, and the motor is run while the various speeds of the transmission are thrown into mesh in order to wear in every gear thoroughly. During this run an electric dynamometer, by means of which a variable load may be applied, is connected to the end of the driving shaft.

An ingenious device for testing the accuracy of gears is used in the factory of the Grabowsky Power Wagon Co., of Detroit. This consists of a standard having three pins or bearings set in it on which the gears of the transmission are placed as shown in Fig. 5, thus forming a replica of the planetary transmission as used in the car. The middle upright bearing is stationary while each of the other two is movable in a horizontal direction and is connected to a micrometer at either end of the base of the instrument. A master gear is set on one of these bearings, while the pinions to be tested are placed on the other two. When the two movable bearings have been so adjusted that all of the gears mesh perfectly, the readings of the two micrometers may be observed and the amount, in thousandths of an inch, by which the gears are "off" may thus be determined accurately. Certain limits of variation are necessarily allowed, but if any gear is below one or above the other, it is thrown out. Inasmuch as the distance between the centers of the gears must be constant in the transmission case, this instrument is useful in determining just what gears are acceptable without the necessity of installing them in the case.

Many of the gears used in the forward end of the motor for driving the cam, pump and magneto shafts are made of

manganese-bronze. The Premier car, however, made in Indianapolis, employs a laminated gear for the magneto shaft, built up of alternate layers of bronze and fiber. These layers are pinned firmly together and the gear is then cut by the usual methods. This makes an exceedingly quiet-running gear, as the layers of fiber or rawhide cushion the impact of the teeth as they meet, and the whirring or grinding sound familiar in many all-metal gears is practically eliminated. It has been found by means of a series of exhaustive tests conducted in this factory that the silent running of this gear is brought about by a slight rounding or "bulging" of the face of the rawhide sections caused by the absorption of the lubricating oil in the pores of the fiber and the pressure against its sides. This, as mentioned above, effectually cushions the impact of the teeth, but if this bulge becomes too great, the teeth will not mesh properly, there will be a tendency to "jam" and more friction will be set up than would be the case were an all-metal gear used. Of course the wider these fiber sections are, the greater will be the bulge to each, and it has been found as a result of these experiments that laminated gears composed of layers of rawhide about ⅛ of an inch thick, alternating with bronze disks of the same dimensions, give the best service for this purpose. When sections of this thickness are used, a sufficient bulge is formed to cushion the impact satisfactorily, and yet this is not great enough to change the shape of the teeth materially. These experiments are still in progress at the factory in question in order the more accurately to determine other facts and figures concerning the best form of laminated gears, and this is only one of the many instances which give evidence to the fact that the American motor car manufacturer is now fully awake to the importance of paying attention to the most minute detail of design.

* * *

SIMPLIFIED METHODS FOR FLY-WHEEL CALCULATIONS*

R. J. WILLIAMS†‡

In several previous issues of MACHINERY methods and formulas have been given relating to the design of fly-wheels and the size of motor required for giving out a certain amount of energy per stroke of the machine under consideration. In this article a method of calculation will be given whereby the work of finding the desired results may be considerably shortened.

In shears of large size cutting short pieces, where the maximum effort may be required almost continuously it is of great importance that motor and fly-wheel be of sufficient capacity to perform their work properly. Since the amount of energy to be given out by the fly-wheel depends upon the size of the motor, this should always be determined first.

Let

E = total energy required per stroke,
E_1 = energy given up by motor during cut,
E_2 = energy given up by fly-wheel,
T = time in seconds per stroke,
T_1 = time in seconds in which E_1 is given up,
T_2 = time in seconds in which E_2 is restored to fly-wheel,
V_1 = initial velocity of fly-wheel in feet per second,
V_2 = velocity after cut in feet per second,
R_1 = initial revolutions per minute of fly-wheel,
R_2 = revolutions per minute after cut,
R_3 = revolutions per minute after n cuts,
W = weight of fly-wheel rim in pounds,
D = mean diameter of fly-wheel rim in feet,
H_1 = horse-power required to cut every stroke,
H_2 = horse-power actually used,
a = width of fly-wheel rim,
b = depth of fly-wheel rim,
g = 32.16,
n = number of cuts shear will make for a total given reduction in speed.

In the July, 1907, issue of MACHINERY this formula for horse-power was given:

$$\text{H. P.} = H_1 = \frac{EN}{33{,}000},$$

and since $N = \dfrac{60}{T}$ we have

$$H_1 = \frac{E}{550T} \tag{1}$$

$$H_1 = \frac{E_1}{550T_1}$$

$$E_1 = 550\,T_1\,H_1 = \frac{550\,E\,T_1}{550\,T} = \frac{E\,T_1}{T}$$

$$E_2 = E - \frac{E\,T_1}{T} = E\left(1 - \frac{T_1}{T}\right) \tag{2}$$

Having now the energy that must be given out by the fly-wheel, we can proceed as follows:

We know that $E_2 = \dfrac{W}{2g}\,(V_1^2 - V_2^2)$ and that

$$V_1^2 = \left(\frac{D \times \pi \times R_1}{60}\right)^2 = 0.00274\,D^2\,R_1^2$$

$$V_2^2 = \left(\frac{D \times \pi \times R_2}{60}\right)^2 = 0.00274\,D^2\,R_2^2$$

$$V_1^2 - V_2^2 = 0.00274\,D^2\,(R_1^2 - R_2^2)$$

$$E_2 = \frac{W}{64.32} \times 0.00274\,D^2\,(R_1^2 - R_2^2)$$

$$E_2 = 0.0000426\,W\,D^2\,(R_1^2 - R_2^2) \tag{3}$$

$$W = \frac{E_2}{0.0000426\,D^2\,(R_1^2 - R_2^2)} \tag{4}$$

Making $0.0000426\,(R_1^2 - R_2^2) = CR_1^2$ we have

$$E_2 = CWD^2R_1^2 \tag{5}$$

$$W = \frac{E_2}{CD^2R_1^2} \tag{6}$$

In cast-iron fly-wheels it is usual not to exceed a speed which represents a fiber stress of more than 1,000 pounds per square inch of rim cross-section. The stress in pounds due to centrifugal force equals $0.0972\ V_1^2$ for cast iron, and for fly-wheels having a maximum stress of 1,000 pounds per square inch we can develop the following formulas:

$0.0972\,V_1^2 = 1{,}000;\ V_1 = 101.5.$

But $V_1 = \dfrac{D\pi R_1}{60}$, therefore we have

$$101.5 = \frac{D\pi R_1}{60}$$

$$R_1 = \frac{101.5 \times 60}{D\pi} = \frac{1940}{D} \tag{7}$$

$$D = \frac{1940}{R_1} \tag{8}$$

Squaring (7) we have $R_1^2 = \dfrac{1940^2}{D^2}$

Substituting this in (6) we have

$$W = \frac{E_2}{C\,D^2\,\dfrac{1940^2}{D^2}} = \frac{E_2}{1940^2\,C}$$

* For additional information on this and kindred subjects, see the following articles previously published in MACHINERY: A Safe Form of Fly-wheel, July, 1899; Fly-wheel Designing, October, 1899; Safe Speed for Fly-wheels, November, 1902, engineering edition; Fly-wheel Explosions and their Cause, January, 1903, engineering edition; Fly-wheels, June, 1903, engineering edition; Gyroscopic Effect of Fly-wheels on Board Ship, May, 1904, engineering edition; The Bursting of Four-foot Fly-wheels, January, 1905, engineering edition; Sixty-ton Fly-wheel, July 1906, engineering edition; Size, Weight, and Capacity of Fly-wheels for Punches, July, 1907, engineering edition; Formulas for Gas Engine Fly Wheels, August, 1907, engineering edition; Fly-wheels for Planers, November, 1907; On Determining size of Fly-wheels for Motor-driven Planers, December, 1907. See also MACHINERY'S Reference Series No. 40, Fly-wheels.

† Address: Wheeling Mold and Foundry Co., Wheeling, W. Va.

‡ Roy J. Williams was born in Syracuse, Ohio, 1884. He received a high school education and became a mechanical draftsman through home study. He has worked as draftsman with the Labelle Iron Works, Steubenville, Ohio; Mutual Electric & Machine Co., Wheeling, W. Va., and the Wheeling Mold & Foundry Co., Wheeling, W. Va. His specialty is rolling mill design.

Making $1940^2 C = C_1$, and $\frac{1}{C_1} = C_2$ we have

$$W = \frac{E_2}{C_1} = C_2 E_2 \qquad (9)$$

The following are the values of C, C_1, and C_2 for different reductions in speed:

Per Cent Reduction	C	C_1	C_2
2½	0.00000213	8.00	0.1250
5	0.00000426	16.00	0.0625
7½	0.00000617	23.20	0.0432
10	0.00000810	30.45	0.0328
12½	0.00001000	37.60	0.0266
15	0.00001180	44.50	0.0225
20	0.00001535	57.70	0.0173

Size of Rim

Let us assume that the depth of rim equals 1.22 times the width. We have then these formulas for size of rim:

$$a = \sqrt{\frac{W}{12D}} \qquad (10)$$

$$b = 1.22\,a \qquad (11)$$

These two formulas can be changed to suit any required ratio of depth to width of rim.

Let y = required ratio,

$$a = \sqrt{\frac{1.22W}{12Dy}} \qquad (12)$$

$$b = ya \qquad (13)$$

Effect of Changing Size of Motor

Let us now suppose that we do not wish to use a motor large enough to cut continuously, and desire to find how many cuts the machine would make continuously without drifting down more than a certain percentage of the original speed. Transposing (3) we have

$$R_1^2 - R_2^2 = \frac{E_2}{0.0000426\,WD^2}$$

$$\text{Let } \frac{E_2}{0.0000426\,WD^2} = K,$$

$K = R_1^2 - R_2^2$, and

$R_2 = \sqrt{R_1^2 - K}$

$$R_3 = \sqrt{R_1^2 - n\,K + (n-1)K\frac{H_2}{H_1}} \qquad (14)$$

After several reductions we have

$$n = \frac{\dfrac{H_1(R_1^2 - R_3^2)}{K} - H_2}{H_1 - H_2}$$

and since $K = R_1^2 - R_2^2$ we have

$$n = \frac{\dfrac{H_1(R_1^2 - R_3^2)}{R_1^2 - R_2^2} - H_2}{H_1 - H_2} \qquad (15)$$

The time now required to bring the fly-wheel up to full speed again after n cuts will be

$$T_2 = \frac{E_2}{550\,H_2} \qquad (16)$$

Examples

We will now work out some examples illustrating the use of these formulas.

Example 1.—A hot slab shear is required to cut a slab 4×15 inches which, at a shearing stress of 6,000 pounds per square inch, gives a pressure between the knives of 360,000 pounds. The total energy required for the cut will then be $360{,}000 \times \frac{4}{12} = 120{,}000$ foot-pounds. The shear is to make 20 strokes per minute, and with a six-inch stroke the actual cutting time is 0.75 second and the balance of the stroke is 2.25 seconds.

The fly-wheel is to have a mean diameter of 6 feet 6 inches and is to run at a speed of 200 R. P. M.; the reduction in speed to be 10 per cent per stroke when cutting.

$$H_1 = \frac{120{,}000}{3 \times 550} = 72.7 \text{ horse-power.}$$

$$E_2 = 120{,}000 \times \left(1 - \frac{0.75}{3}\right) = 90{,}000 \text{ foot-pounds.}$$

$$W = \frac{90{,}000}{0.0000081 \times 6.5^2 \times 200^2} = 6570 \text{ pounds.}$$

Assuming a ratio of 1.22 between depth and width of rim,

$$a = \sqrt{\frac{6{,}570}{12 \times 6.5}} = 9.18 \text{ inches,}$$

$b = 1.22 \times 9.18 = 11.2$ inches,

or size of rim, say, $9 \times 11\frac{1}{2}$ inches.

Example 2.—Suppose we wish to make the fly-wheel in Example 1 with a stress of 1,000 pounds, due to centrifugal force per square inch of rim section.

C_2 for 10 per cent = 0.0328,

$W = 0.0328 \times 90{,}000 = 2{,}950$ pounds,

$R_1 = \frac{1{,}940}{D}$. If $D = 6$ feet, $R_1 = \frac{1{,}940}{6} = 323$ R. P. M.

$$a = \sqrt{\frac{2{,}950}{12 \times 6}} = 6.4 \text{ inches,}$$

$b = 1.22 \times 6.4 = 7.8$ inches.

or size of rim, say, $6\frac{1}{4} \times 8$ inches.

Example 3.—Let us now suppose that in Example 1 we wish to use a 50 H. P. motor, and wish to find how many cuts the shear will make continuously without drifting down more than 20 per cent in speed? And what time must be allowed for the motor to restore the fly-wheel to its original speed?

$R_1^2 - R_3^2 = 200^2 - 160^2 = 14400$

$R_1^2 - R_2^2 = 200^2 - 180^2 = 7600$

$$n = \frac{\dfrac{72.7 \times 14400}{7600} - 50}{72.7 - 50} = 3.86 \text{ cuts}$$

Allowing the shear to make 4 cuts we have

$$R_3 = \sqrt{200^2 - 4 \times 7600 + 3 \times 7600 \times \frac{50}{72.7}} = 159 \text{ R. P. M}$$

$E_2 = 0.0000426 \times 6570 \times 6.5^2 \times (200^2 - 159^2) = 175{,}000$ foot-pounds, about.

$$T_2 = \frac{175000}{550 \times 50} = 6.4 \text{ seconds.}$$

Example 4.—Let us now suppose that in Example 2 we wish to use a 50 H. P. motor under the same conditions as in Example 3.

$R_1^2 - R_3^2 = 323^2 - 258^2 = 37750$

$R_1^2 - R_2^2 = 323^2 - 291^2 = 19650$

$$n = \frac{\dfrac{72.7 \times 37750}{19650} - 50}{72.7 - 50} = 4 \text{ cuts, nearly.}$$

$E_2 = 0.0000426 \times 2950 \times 6^2 \times (323^2 - 258^2) = 170{,}000$ foot-pounds, about.

$$T_2 = \frac{170{,}000}{550 \times 50} = 6.2 \text{ seconds.}$$

These examples show the possibilities of the formulas as time-savers for the designer, by reducing the calculations to the smallest possible number, and at the same time reducing the possibility of error.

* * *

Vice-Consul-General Richard Westacott reports that on July 1 there were 3,394 public motor cabs in use in London, this being an increase of 1,886 over the number one year ago. In other words, the number of motor taxicabs has more than doubled in a year, while the number of licensed horse-drawn hansom cabs decreased 1,290 in one year, and the number of four-wheeled horse-drawn cabs decreased by 389. The total number of all kinds of public cabs in London is nearly 11,000.

GLENN H. CURTISS

THE MAN, THE AEROPLANE AND THE MOTOR

Glenn H. Curtiss

Glenn Hammond Curtiss was born May 21, 1878, at Hammondsport, N. Y. Here he received his early education and planned for the future, although he hardly could have dreamed of what he has actually been able to accomplish, namely to go faster on the ground than any other person, and to fly through the air and win in competition over the best aviators of the world.

Mr. Curtiss attended school in Rochester, N. Y., and started in the bicycle business in Hammondsport in 1900. It was at this time that he built one of the first motor cycles ever constructed in this country, and he says that he never since has had such pleasure from any of his successes as came to him when, for the first time, the motor made a few explosions and ran for half a block.

On January 23, 1907, at Ormond Beach, Fla., Mr. Curtiss made a record for the distance of one mile in the extraordinary time of 26 2/5 seconds with a 40-horse-power air-cooled motor cycle which he had built entirely in his own factory. This is the fastest speed ever made with any form of vehicle, and means a speed of about one hundred and thirty-seven miles an hour.

Mr. Curtiss' first interest in aeronautics came from Captain Thomas S. Baldwin who, in seeking a good motor to drive his airships, found the Curtiss the best and most reliable for the purpose. Mr. Curtiss built the first water-cooled motor to be used in the dirigible balloon which Captain Baldwin built for the United States Signal Corps and which made 19.61 miles an hour in its official speed test and flew in its official endurance trial for two hours. Mr. Curtiss operated the engine while Captain Baldwin steered the airship during its flights which were held at Fort Myer, Va., near Washington. These flights, and one made a short time previously, were the first opportunities that Mr. Curtiss had to navigate the air.

In the latter part of 1907 the Aerial Experiment association was formed by Dr. Alexander Graham Bell, the inventor of the telephone, who is greatly interested in the subject of aeronautics, and Mr. Curtiss was appointed the director of experiments. The other members of the association were Mr. F. W. Baldwin, M.E., Toronto University, chief engineer, who made the first public flight in America in a heavier-than-air flying machine, March 12, 1908, in the first machine built by this association, Selfridge's *Red Wing*, which flew over the ice on Lake Keuka, near Hammondsport, N. Y. The treasurer of this association was Mr. J. A. Douglas McCurdy, M. E., Toronto University, who was also assistant engineer and secretary since the death of Lieut. Selfridge. Mr. McCurdy made over three hundred successful flights, averaging nearly nine miles each and covering in the neighborhood of three thousand miles. These flights were made over the ice in Baddeck Bay, Nova Scotia, in his machine the *Silver Dart*, built by the association. The other member of this association was Lieut. Thomas E. Selfridge, military expert in aeronautics detailed by the United States government to observe the experiments of the association, in the interest of the United States Army and acting as secretary of the association. Lieut. Selfridge was killed September 17, 1908, in the accident to Orville Wright's flying machine at Fort Myer, Va., near Washington, D. C. This is the first and only serious accident recorded in the recent* work of aviation, and of many thousands of flights in public in heavier-than-air machines there are only six recorded fatal accidents.

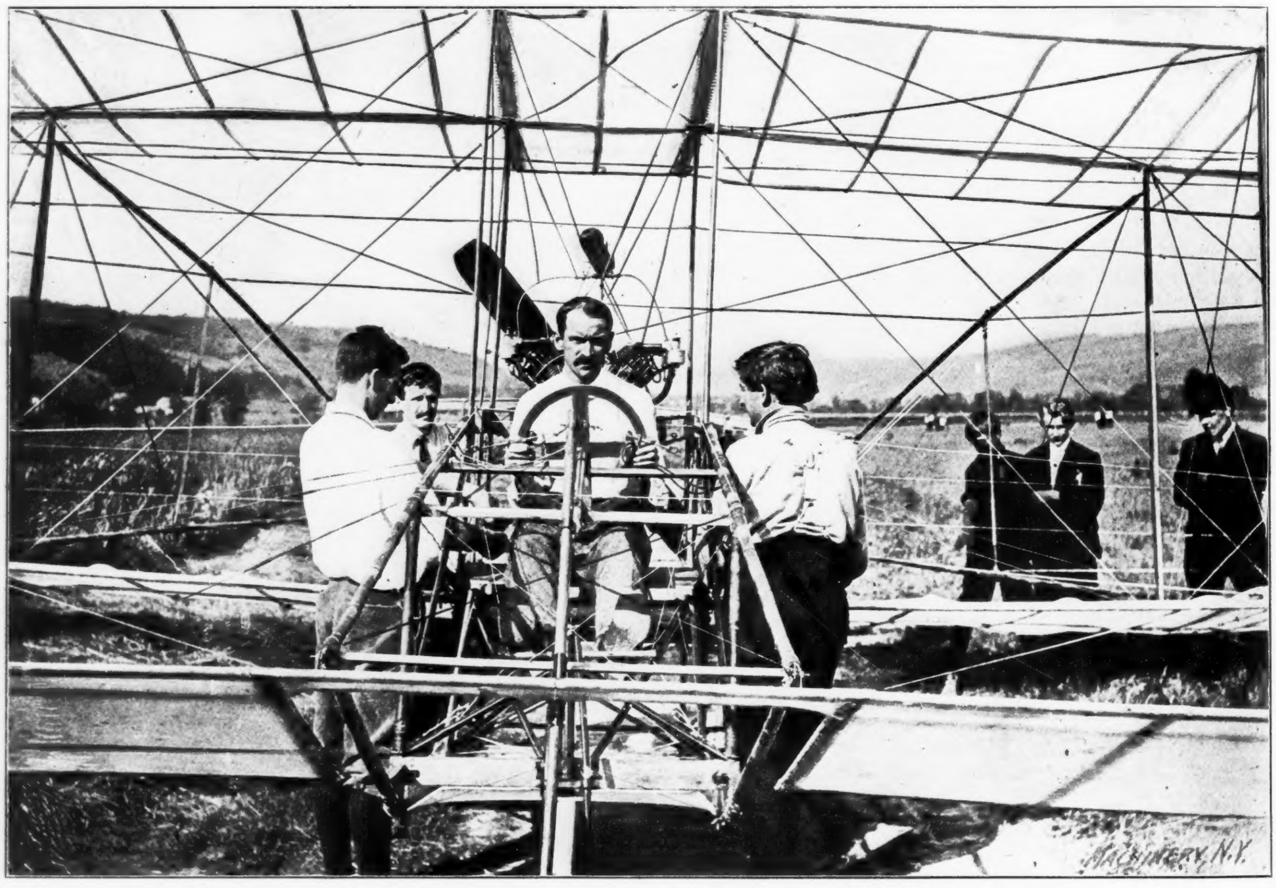


Fig. 1. Glenn H. Curtiss in the "June Bug," Ready for Flight

The third machine built by the association was the *June Bug* and on July 4, 1908, with it Mr. Curtiss contested for and won the *Scientific American* trophy, offered to the first machine heavier than air to fly one kilometer in a straight line. In this contest he made a record of 1¼ mile in 1 minute 42 2/5 seconds.

Three more machines were built, including the machine which one year later made a second record for the *Scientific American* trophy, July 17, 1909, flying 24.7 miles in 52 minutes

* See article, "Aeroplane-Type Flying Machines," December, 1908.

* Since this article was written S. Lefebvre was killed at Juvisy-sur-Orge, France, September 7.

30 seconds, and the machine in which, representing the Aero Club of America, Curtiss won the Gordon Bennett International Aviation Cup at Rheims, August 28, 1909, flying 20 kilometers (12.42 miles) in 15 minutes 50 3/5 seconds, a speed of 47 miles an hour, bringing this famous cup and contest to America where the race for it will be held next year. Mr. Curtiss also won, during the "Aviation Week at Rheims," the Prix de la Vitesse by flying over a course of 30 kilometers in length, in 23 minutes 29 seconds, surpassing the best records of the foremost aviators in the world.

A description of the machine with which Mr. Curtiss accomplished these wonderful results will be interesting:

The Herring-Curtiss No. 1, as it is now called, is a biplane with front control, rear control, side control or wing tips, starting and landing wheels, and motor. The main surfaces are 28 feet 9 inches by 4 feet 6 inches, one superimposed upon the other and separated by vertical struts, 4 feet 6 inches being the distance between the two planes. These planes are

Fig. 2. The "Gold Bug" in Flight

covered with Baldwin rubber-silk material and the total area is about 258 square feet. There are twenty-two ribs used in the surfaces made of spruce and ash laminated and formed to a curve; they are spaced 15 inches apart and the covering material is laid over them and fastened by a strip of featherbone, laid on the upper side of the material and tacked to the ribs. The angle of these surfaces to the direction of motion is between 4 and 5 degrees when flying. The front control consists of two surfaces each 6 feet wide and 2 feet deep and 2 feet apart and placed about 12 feet in front of the main planes. This whole structure, like a box-kite, is pivoted ten inches back from its front edge upon the frame-work which extends in front of the machine; a rod is connected to the upper part of this control and extends to the steering wheel which can be moved forward or back, thus turning the

Fig. 3. Glenn H. Curtiss on a Motor-driven Ice Boat, on Lake Keuka, near Hammondsport, N. Y.

front control or rudder on its axis making the surfaces point up or down. This tends to raise or lower the front of the machine as, according to its positive or negative inclination, the wind blows against the upper or under side of this front rudder. The rear control consists of a horizontal surface or tail 2 feet 3 inches by 6 feet at the extremity of the framework, about 12 feet in the rear of the main planes, about the same distance to the rear that the front control is ahead of the

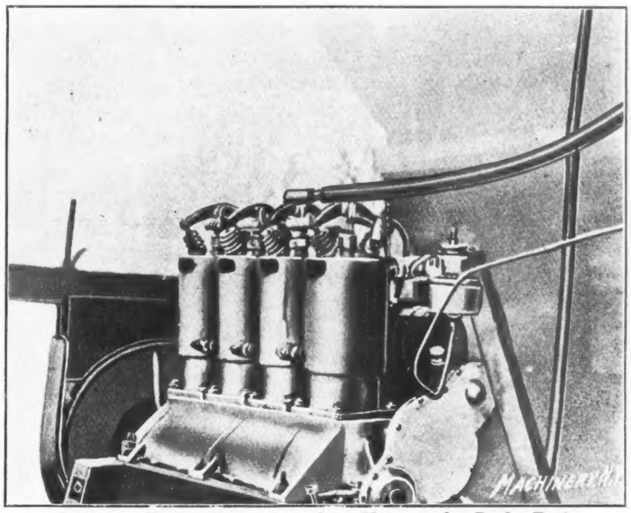


Fig. 4. A Four-cylinder Aeroplane Motor under Brake Test

machine. There is also a vertical rudder 2 feet by 3 feet 4 inches, pivoted 8 inches back from its front edge which is connected by wires to the steering wheel which turns and steers the aeroplane in the horizontal plane in the same manner that a rudder steers a boat in the water.

The side control or wing tips which govern the balancing are perhaps the simplest form of apparatus for accomplish-

Fig. 5. G. B. von Rattweiler, Designer of the first Three Curtiss Motors, holding a Four-cylinder Motor and Propeller in his Hands

ing this most essential feature and one that has baffled inventors of flying machines more than any other one point. These small surfaces are placed between the main planes at their outer extremity and are 6 feet wide and 2 feet deep. They are hinged at their front edge and both are connected to a pivoted lever in the center of the machine which has a yoke or fork extending on each side of the operator's shoulders in such a manner that when he leans to one side or the other this movement will cause the side planes to act in unison, one, however, pointing down as the other points up. If the machine tips so that the right-hand side is lower than the other, the operator naturally leans to the left or highest side. This movement causes his shoulder to press against

the lever, thereby moving it to the left, and by means of the wires which extend to the planes the right-hand plane is turned to a lifting angle and the left-hand plane to the contrary or a depressing angle in such a manner that the wind will blow against the under side of the right-hand plane and against the upper side of the left-hand plane, thus forming a "couple" tending to right the machine.

The materials of which the machine is constructed consist of Oregon spruce, which is used in the main frame-work, and bamboo which is used in the frame-work supporting the forward and rear controls; steel wire is used for the main bracing and a fine strand wire cable for other bracing and to operate the rudders and controlling planes. The structure for mounting the three 20-inch pneumatic tire wire wheels upon which the machine runs when starting and alighting is made of steel tubing and wood. These wheels are provided with extra wide hubs in order to enable them to withstand any severe lateral strain in landing, and a long skid or reach bar of wood extends from the center of the axle of the two rear wheels, which are directly under the lower main supporting plane, to the single front wheel from which wooden braces extend directly to the engine bed and the upper plane to take up the shock of landing.

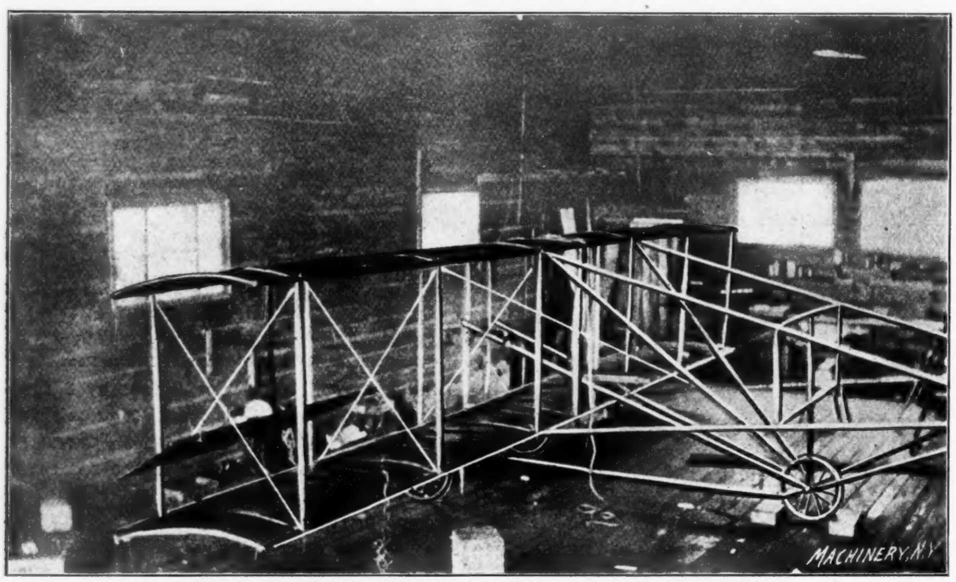


Fig. 6. The "Gold Bug" in Curtiss' Shop at Hammondsport, N. Y.

The operator's seat is just in front of the motor and in the center of the main planes, slightly toward the front of the central panel. The steering wheel is directly in front of him, which he pushes away from him to go down and pulls back to go up, and turns to the right or left to steer in the horizontal plane. At his right foot which rests on a cross-bar is a pedal operating a brake on the front wheel used to bring the machine more quickly to a standstill after landing, and at the same time operating a switch to cut off the motor. The left foot has a small pedal operating the throttle and governing the speed of the engine.

The Curtiss motor is perhaps as important, if not more important, than any other part of the aeroplane. Very few flying machine builders build their own motors, and many were delayed or kept from success by the lack of a good motor. The Wright brothers built a flying machine and then built their motor, while Mr. Curtiss had developed his motor to a state approaching perfection and then built his flying machine.

The motor ordinarily used is a four-cylinder, four-stroke cycle engine, water-cooled by geared pump, with gray iron cylinders 3⅞ by 4⅛ with steel water jackets, giving 28 horsepower at 1,450 revolutions per minute on a water-cooled brake test of six hours continuous running. The compression is high, being about 92 pounds. The lubrication is by high pressure oil system, the pump being built in the crank-case and operated from the cam-shaft, the oil being forced through the cam-shaft which is made of one piece with a 5/16 hole. The oil passes to the main bearings which are plain and to the hollow crank-shaft, 1⅞ inch diameter, which is made of Krupp chrome nickel steel. The oil returns to a reservoir underneath the engine and is pumped over again through the system. The ignition is by Simms-Bosch high-tension magneto. "Mercedes" spark plugs are used, and a Curtiss carbureter. The valves, both in the head of the cylinder, are mechanically operated, very ingeniously, by a rocker arm and a single push rod and cam. The crank-case is of aluminum alloy, also the pistons and connecting-rods. The weight of the engine complete with propeller, carbureter and magneto is about 92 pounds. The propeller is made of wood 5 feet 4 inches in diameter with a five-foot pitch and gives a thrust of 225 pounds pulling against a scale.

The total weight of the machine with operator is about 550 pounds and the complete power plant, including radiator, water and oil, weighs about 195 pounds.

The machine used in Rheims were fitted with an eight-cylinder motor, with cylinders 4 by 4.5 inches placed together like the letter V. It is practically two of the four-cylinder motors put together, weighs, complete, about 200 pounds, and develops about 60 H.P. A large thirteen-gallon and a small three-gallon fuel tank were fitted for the long races and the speed tests respectively. Fifteen inches of surface were taken off each main plane, and the side controls were arched and placed a little further out at the extremities. The propeller gave a thrust of 280 pounds, and the total weight of the whole machine loaded was about 700 pounds. Mr. Curtiss also made some changes in his propeller at Rheims to get the highest efficiency out of his machine, for the relation of speed of the machine, speed of the motor, and size and pitch of the propeller is very important. A. P.

* * *

Many hospitals in England, says the *Scientific American*, are provided with a special apparatus for extracting iron and steel chips from the eye by means of powerful electro magnets. The magnet employed has a core three feet long and six inches in diameter of the best Swedish soft iron. Two hundred pounds of insulated wire are wound in two coils about the core. The end of the magnet is threaded to receive terminals of different shapes to suit various conditions. The magnet is mounted on ball bearings, and can be moved in any direction. The strength of the magnetic field may be varied at will by means of a rheostat. When used at its maximum power, the magnet exerts a pull of 30 pounds per square inch at a distance of an inch. A special type of apparatus is provided for reclining patients; in this case the magnet is mounted on trunnions, and is tilted by means of suitable gearing operated by a hand crank.

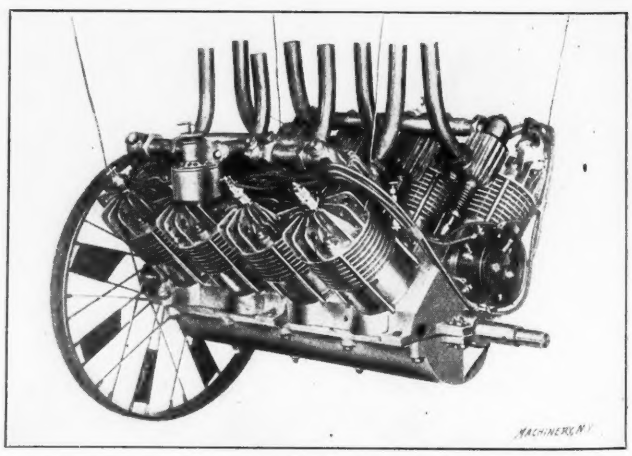


Fig. 7. Forty Horse-power Eight-cylinder, Air-cooled, Curtiss Motor, weighing 145 pounds

BEGINNING OF STEAM NAVIGATION*

Robert Fulton

The one-hundredth anniversary of the successful application of steam to the propulsion of ships by Robert Fulton, and the three-hundredth anniversary of the exploration by Henry Hudson of the river that bears his name, is now being commemorated by a great celebration given by the state of New York. This dual celebration, which is under the auspices of the Hudson-Fulton Commission, began on September 25 and will continue until October 9. It will doubtless surpass, in magnitude and grandeur, anything which has been held on this side of the Atlantic, as every detail which would contribute to its success has been carefully planned and a vast sum of money, roughly estimated at one million dollars, has been expended. As far as possible, exact replicas of Hudson's vessel, the *Half Moon*, and Fulton's historic *Clermont* with which he demonstrated the practicability of the steamboat, have been built. These quaint craft will, in connection with a great naval parade, be convoyed on October 1st by a fleet of American and foreign men-of-war, up the Hudson.

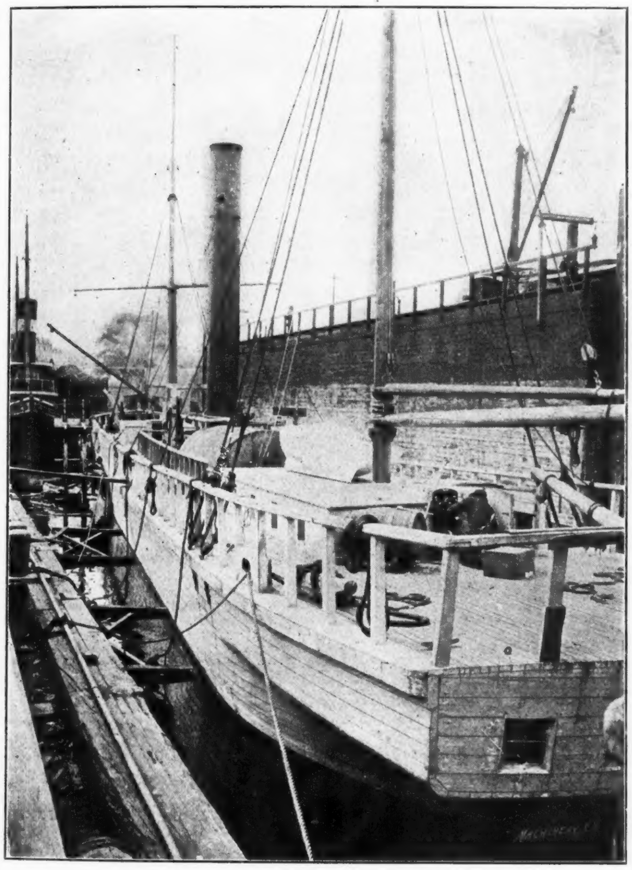


Fig. 1. The Replica of the Clermont

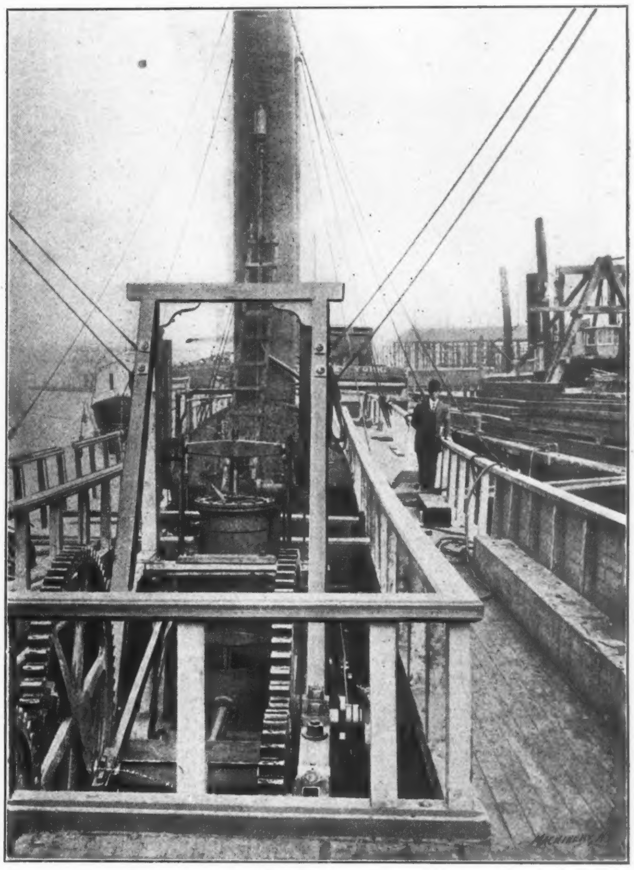


Fig. 2. View of the Engine after Installation

As is well known, Robert Fulton was not the first man to build a steamboat, a number of other boats using steam having preceded the *Clermont;* but if we may judge from descriptions and models of some of these, their priority detracts but little from Fulton's achievement, as he constructed the first boat that was a commercial success. Nevertheless, much that Fulton accomplished was undoubtedly due to the ideas he obtained from those whose experiments antedated the construction of the *Clermont.* James Rumsey began experimenting as early as 1785, and a year later John Fitch is said to have constructed the first steam-propelled craft which met with any degree of success in America. It was a most clumsy contrivance, however, being propelled by gangs of oars arranged in a frame-work at the sides. The second American steamboat was run by Fitch on the Delaware at Philadelphia in 1787. In the same year Rumsey is said to have built the third boat which operated on the Potomac. The propulsion of this novel craft was accomplished by sucking in water at the bow and expelling it at the stern—a method which has been tried in recent times, but without success. In the two following years Fitch built two other steamboats, after which Samuel Morey built a stern-wheeler, which made a trip from Hartford to New York. Fitch, who had been conducting his experiments on the Delaware at Philadelphia, came to New York where he operated the seventh American steamboat on the old Collect Pond, a small body of water which then existed where the City Prison and Criminal Courts Building now stand. This boat was propelled both by paddle wheels at the side and a screw propeller. The construction of the mechanism was exceedingly crude and primitive, the boiler being made from a ten-gallon iron kettle, which was closed by a heavy plank lid. The factor of safety was probably a most uncertain quantity.

John Stevens began his work in steam navigation in 1791. In 1798, a steam-propelled vessel was tried on the Passaic River. The New York Legislature was petitioned by Stevens for a monopoly of steam navigation, but the petition was not granted. In 1804 a 68-foot boat, 14 feet wide, fitted with a single-screw propeller, was built by Stevens and in 1805 a twin-screw boat was launched on the North River. The machinery of this boat was afterward placed in a larger boat, the *Phoenix*, which was 103 feet 3 inches long, 16 feet wide, and 6 feet 9 inches deep. While the launching of the *Phoenix* occurred after that of the *Clermont*, if one may judge from models, the lines of Steven's craft were much superior to those of the *Clermont*. The engine also shows greater simplicity. In the spring of 1809, the *Phoenix* made a number of trips between New York and New Brunswick, a distance of 37 miles, in 9½ hours including stops, but perhaps owing to the fact that the nearly completed *Rariton* (Fulton's second boat) was intended for operation over this course, it was decided to sail the *Phoenix* to the Delaware River by way of the Atlantic. She left New York on June 8, 1809, arriving at Philadelphia on June 17. Thus was accomplished the first sea voyage of a steam-propelled vessel. The *Phoenix* ran as a passenger boat on the Delaware, stopping at Philadelphia,

* For additional information on this subject, see the article on "Early Steam Navigation," published in the May, 1902, number of MACHINERY.

Bordentown, and Trenton where connection was made with stages across New Jersey to New Brunswick, one of the terminals of the *Raritan*. After running for a number of years over this route the *Phoenix* was wrecked at Trenton in 1814.

The original *Clermont* was built at Charles Brown's shipyard near Corlear's Hook, New York. According to a letter written by Fulton to James Watt, she was 175 feet long, had a beam of 12 feet, and a depth of 8 feet. After making four trips the length was reduced to 150 feet and the width increased to 18 feet. The hull was flat bottom, and wedge shaped at both the bow and stern. The sides were nearly vertical, the width across the main deck being only a little more than at the bottom. As there was no keel, two steering-boards or leeboards were provided to prevent drifting sideways. The propulsion was by paddle wheels, 15 feet in diameter, which were placed well forward. These were driven by

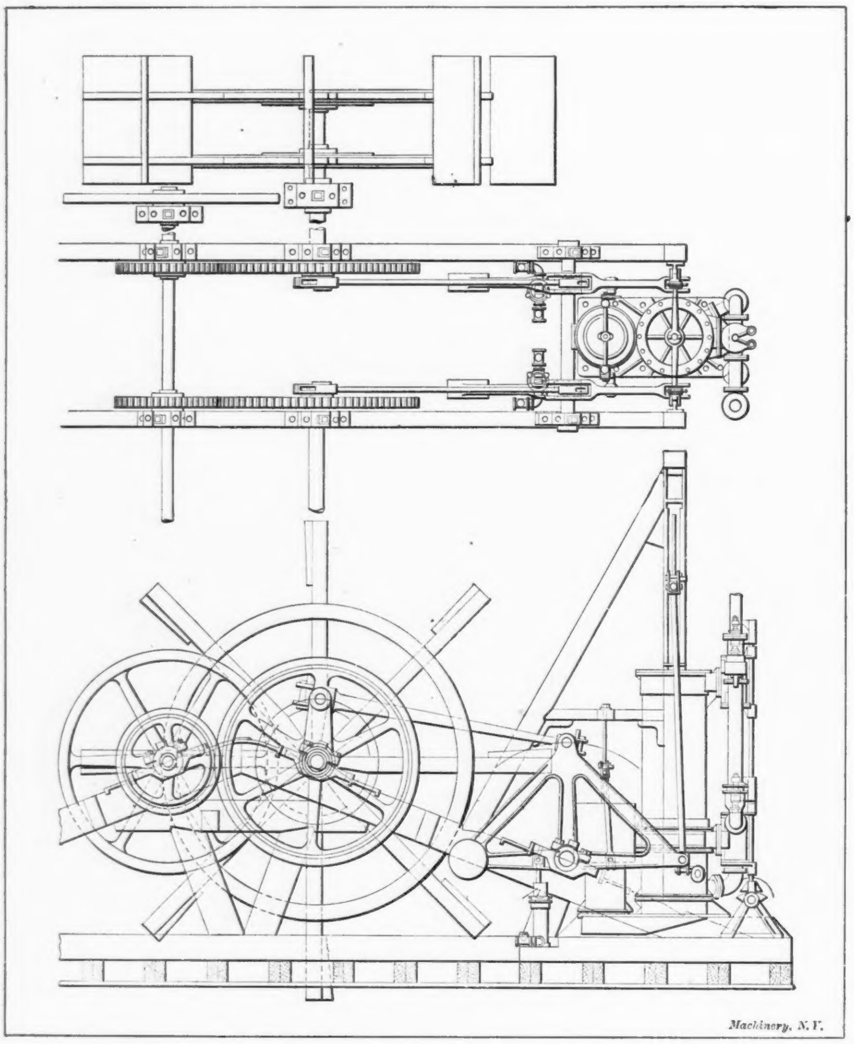


Fig. 3. Plan and Elevation of the Engine which was built for the new Clermont

a single-cylinder condensing engine of the side-lever type, which was imported from England, as the facilities in this country at that time for engine building or similar work were very poor. This engine with its driving mechanism was located amidships, and was uncovered. An idea of its construction may be obtained by referring to Fig. 3 which shows an elevation and plan of the engine built for the new *Clermont*. Fig. 2 shows the appearance of the engine after installation. The cylinder, which was designed for a working pressure of 20 pounds, is mounted vertically on a cylindrical condenser, which is connected to the air pump by a channel-way of cast iron, which forms the bed-plate of the engine. The valves, which are of the single poppet type, are located in cylindrical steam chests arranged at each end of the cylinder. The valve gear of the first *Clermont* required four men to start the engine. It was afterwards changed to the Stevens type, the fundamental principles of which are seen in the engines of the modern river boats. The diameter of the cylinder is 24 inches, and the length of stroke 4 feet. The fly-wheels are located outside of the hull, and are driven from the paddle-shafts on either side by two-to-one gearing. This gearing is of cast iron, and machine molded. The fly-wheels are also cast iron and have a rim section of 4 x 4 inches. It is said that upon one occasion when one of the paddle-wheels was disabled, paddles were attached to the fly-wheel and the voyage continued. The side-levers, which are connected with the cross-head and paddle-shaft cranks, are counterweighted as shown, to balance the weight of the piston-rod, crank, air-pump gear, etc. The air pump is single-acting and is connected with the side-levers by links. From the cross-head of the air pump the feed and bilge pumps are driven.

The boiler of the original *Clermont* was of copper, but no attempt at an exact reproduction of this part has been made, as such a boiler would not pass the United States inspection laws. With this single exception, however, the new *Clermont* is said to be an accurate reproduction of the original. The problem of constructing such a boat was exceedingly difficult, for while drawings of the engine were in existence there was no contemporary picture of the hull. After a careful and painstaking investigation on the part of her architects, the firm of J. W. Millard & Bro. in conjunction with Mr. Frank E. Kirby, consulting engineer, sufficient data were obtained to accomplish the desired result.

The famous voyage of the original *Clermont* from New York to Albany began on August 17, 1807. The start was made from a point near the square, which is now bounded by Washington, West Tenth, West and Charles Streets. Leaving New York at one o'clock in the afternoon, the *Clermont* arrived at the estate of Chancellor Livingston, at 10 o'clock on Tuesday, having traveled 110 miles in 24 hours at an average speed of 4.6 miles per hour. On the remaining 40 miles of the journey to Albany, this speed was increased to 5 miles per hour, making 32 hours the total time for the trip. The next day the return journey began, and just 30 hours afterward the maiden voyage was ended.

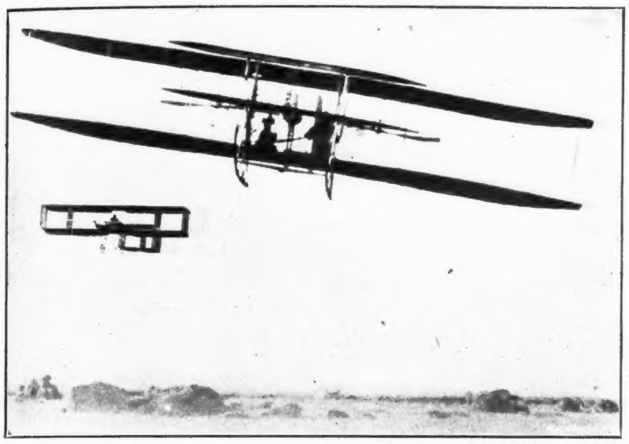
On returning from the first trip, the *Clermont* underwent some improvements to better fit her for regular passenger traffic. At the end of this time the following rates to various points from New York were advertised: Newburgh, $3, time 14 hours; Poughkeepsie, $4, time 17 hours; Esopus, $4.50, time 20 hours;; Hudson, $5, time 30 hours; Albany, $7, times 36 hours. Under favorable conditions trips were made to Albany in 28 hours, at a rate of 6 miles an hour. At times as many as 100 passengers were carried. These trips were continued until late in the fall of 1807, and the service was resumed in the spring of 1808. In writing to Livingston of the financial return from passenger traffic, Fulton says: "By carrying for the usual price there can be no doubt but the steamboat will have the preference because of the certainty and agreeable movement. I have seen the captain of a fine sloop on the Hudson. He says the average of his passages has been 48 hours. For the steamboat it would have been 30 hours certain. The persons who came down with me were so pleased that they said were she established to run periodically they would never go in anything else."

The construction of the *Clermont* did not mark the beginning nor the end of Fulton's achievements, for both prior and subsequent to the advent of this famous craft, his genius expressed itself in valuable pioneer work with submarine boats, torpedoes, inland canals, and in other directions in the realm of mechanics and marine construction; and, through the efforts of this early inventor, much was accomplished toward laying the foundation of our present natuical development.

AVIATION RECORDS AT RHEIMS

A. P.

The international meet of flying machines or "Aviation Week," at Rheims, France, in the latter part of August, was the most notable event in the history of aviation. America was ably represented by Mr. Glenn H. Curtiss, who won the Gordon-Bennett International Aviation Cup, on August 28. He represented the Aero Club of America, with a machine of his own make, and defeated one representative of England using a French machine, and three representatives of the Aero Club of France. Mr. Curtiss flew 20 kilometers (12.42 miles) in 15 minutes 53 3/5 seconds, his speed being about 47 miles an hour. His nearest rival was M. Louis Bleriot who made

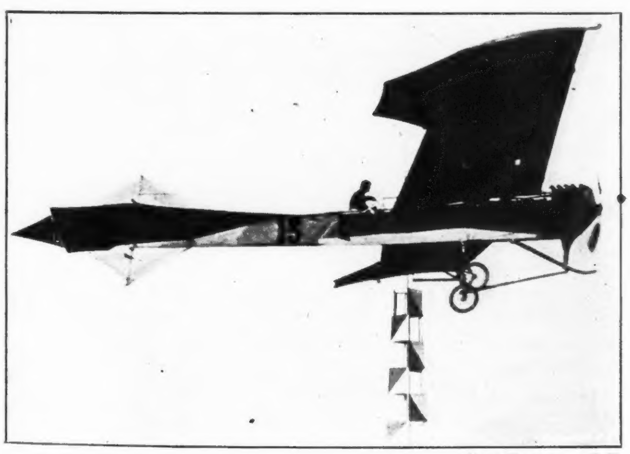


Paul Thompson, N. Y.

Fig. 1. The Wright Machine at Rheims followed by Paulhan. Two Machines caught by the Photographer in the Same View

the course in 15 minutes, 56 1/5 seconds, while Mr. Latham got third place, his time being 17 minutes, 32 seconds. M. Lefebvre made fourth place, his time being 20 minutes, 47 seconds. Each contestant was allowed only one trial. The prize was a trophy valued at 12,500 francs ($2,500), which goes to the club of which the contestant was a representative, and a cash prize of 25,000 francs ($5,000) to the winner.

The Gordon-Bennett contest was the culmination of the most intensely interesting sporting event ever held in the history of the world, and was epoch-making in the annals of mechanical flight. The contest revealed a new field of sport and pleasure heretofore absolutely unknown except to scientists and inventors.



Paul Thompson, N. Y.

Fig. 2. Bleriot rounding Turn at Rheims. View taken from Paulhan's Machine

Curtiss also won the Prix de la Vitesse of 20,000 francs ($4,000), making 30 kilometers (18.63 miles) in 25 minutes, 29 3/5 seconds with the penalization of one-tenth. Bleriot won the prize for the fastest time for one round of the course, 10 kilometers (6.21 miles) in 7 minutes, 47 seconds. Henry Farman won the Grand Prix de Champagne, 50,000 francs ($10,000) by a world's record flight of 180 kilometers (111.98 miles) in 3 hours, 4 minutes, 56 seconds. He flew after the official hour for the timers to leave, 7:30 o'clock, until he had covered 190 kilometers, the time being 3 hours, 15 minutes. The excess distance, however, is not a part of the official record. Mr. Farman also won the passenger carrying contest, carrying two passengers 10 kilometers (6.21 miles) in 9 minutes, 52 seconds. Herbert Latham won the Prix de l'altitude, 10,000 francs ($2,000), reaching a height of 155 meters, or over 500 feet.

There were six principal types of machines used, the Wright and the Curtiss biplanes (American), and the French biplanes of Farman and Voisin, and the monoplanes of Latham (Antoinette) and Bleriot. It is estimated there were altogether 1,300 flights made during the aviation week. The following is a tabulated record of the principal events, competitors, and time:

GRAND PRIX DE CHAMPAGNE

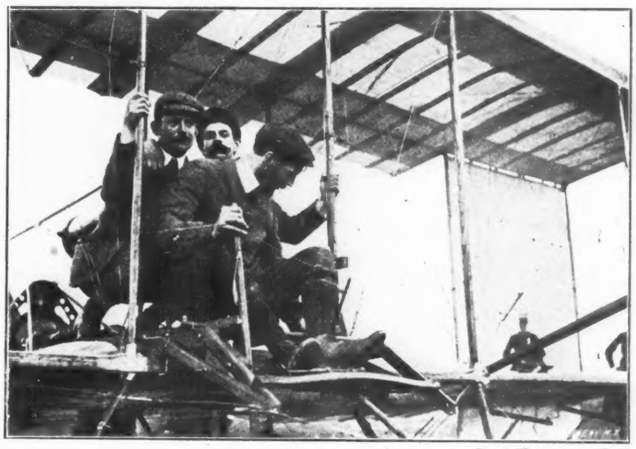
(Long Distance Test)

	Competitor	Machine	Kilometers	Time	Prize, Francs
1.	Farman	Farman	180	3h. 4 m. 56s.	50,000
2.	Latham	Antoinette	154½	2h. 1 m. 19s.	25,000
3.	Paulhan	Voisin	131	2h. 43m. 24s.	10,000
4.	De Lambert	Wright	116	1h. 52m.	5,000
5.	Latham	Antoinette	111	1h. 38m. 15s.	5,000
6.	Tissander	Wright	110	1h. 46m. 52s.	5,000

PRIX DE LA VITESSE, 30 KILOMETERS

(Three Lap Speed Test)

	Competitor	Machine	Time	Prize, Francs
1.	Curtiss	Curtiss	23m. 29s.	10,000
2.	Latham	Antoinette	25m. 18s.	5,000
3.	Tissander	Wright	28m. 59s.	3,000
4.	Lefebvre	Wright	29m.	2,000



Paul Thompson, N. Y.

Fig. 3. Henry Farman about to engage in the Contest in which he carried Two Passengers and made the Circuit in 10 minutes 39 seconds

PRIX DE TOUR DE PISTE, 10 KILOMETERS

(One Lap Speed Test)

	Competitor	Machine	Time	Prize, Francs
1.	Bleriot	Bleriot	7m. 47s.	7,000
2.	Curtiss	Curtiss	7m. 49s.	3,000

COUPE INTERNATIONAL GORDON-BENNETT TROPHY AND 25,000 FRANCS

	Competitor	Country	Machine	Time
1.	Curtiss	America	Curtiss	15m. 50s.
2.	Bleriot	France	Bleriot	15m. 56s.
3.	Latham	France	Antoinette	17m. 32s.
4.	Lefebvre	France	Wright	20m. 47s.

PRIX DE L'ALTITUDE, 10,000 FRANCS

(Soaring Test)

	Competitor	Height		Competitor	Height
1.	Latham	155 meters	3.	Paulhan	90 meters
2.	Farman	110 meters	4.	Rougier	55 meters

PRIX DU PASSAGERS, 10,000 FRANCS, 10 KILOMETERS

(Passenger Carrying Test)

	Competitor	Machine	Passengers	Time
1.	Farman	Farman	1	9m. 52s.
2.	Farman	Farman	2	10m.39s.
3.	Lefebvre	Wright	1	11m.20⅘s.

* * *

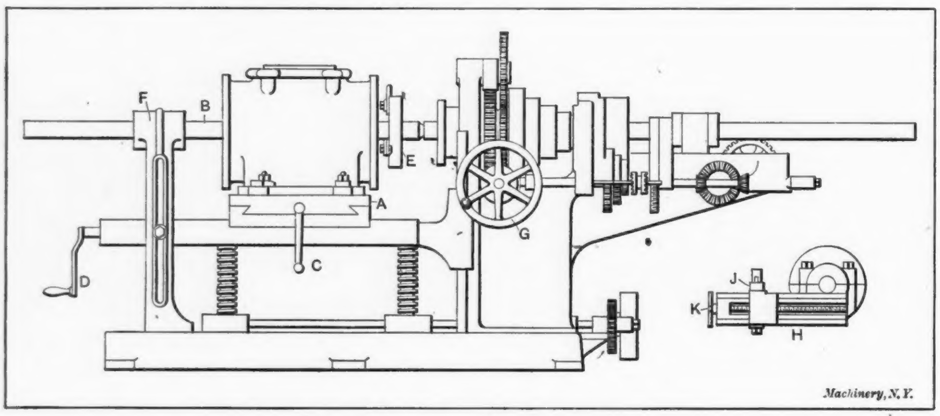
A centennial exposition and world's fair will be held in Winnipeg, Manitoba, in 1912, according to a report by Vice-Consul-General Carl R. Loop.

* The following notes and articles giving records obtained with aeroplanes and airships have previously been published in MACHINERY: Delagrange record, August, 1908; Zeppelin, August, 1908, engineering edition; various aeronautic records, October, 1908, engineering edition; miscellaneous records mentioned in an article entitled "Aeroplane-Type Flying Machine," December, 1908, engineering edition; Wilbur Wright's record, March, 1909; Bleriot's flight across the English Channel, August, 1909.

MACHINE SHOP PRACTICE*

BORING CYLINDERS

The type of machine tool used for boring cylinders, and also the method of procedure is determined largely by the size of the work and the quantity which is to be machined. The lathe of both the plain and turret types, as well as horizontal and vertical boring mills are used for this work, and in automobile factories or other shops where a great many cylinders are bored, special machines are often employed. When a common lathe is used, the casting, providing it is too large to be bolted to the face-plate or held in the chuck, is clamped to the lathe carriage, with sufficient blocking beneath it to bring the rough bore in alignment with the lathe spindle. A boring-bar equipped with one or more cutters centrally located, is mounted between the lathe centers and driven by a dog. As the cutters revolve, the work is fed against them by the regular carriage feed. As the boring-bar is the only special tool needed when the work is done in the lathe, cylinders are often bored in this way in shops which do not have a boring machine. If cylinders are to be bored in quantity by this method, a special fixture should be provided for holding them upon the carriage, which is so designed that clamping and adjusting may be quickly done.



Horizontal Boring and Drilling Machine

The Shop Operation Sheet accompanying this number gives an example of small cylinder boring in the turret lathe; the cylinder being of the type used for gasoline engines. By referring to the illustrations and descriptions, it will be seen that the turret, which is, practically speaking, a large tool holder, is equipped with boring tools for both roughing and finishing cuts; also a reamer for finishing the cylinders to size. As these tools may be brought into position as needed by simply revolving the turret, it is possible with such a machine to do work with considerable rapidity.

The accompanying engraving shows the general construction of a common type of horizontal boring and drilling machine, and also the way a cylinder is set up for boring. The table *A* to which the cylinder is clamped, has a horizontal adjustment, both lengthwise and crosswise of the bed, and also a vertical adjustment so that the cylinder to be bored can easily and quickly be set in alignment with the boring-bar *B*. The horizontal adjustments are effected by the handles *C* and *D*, while the table is raised and lowered by power. The boring-bar is supported and kept in alignment with the spindle by an outboard bearing *F*, through which it slides as the cutters in the boring head *E* are fed through the work. This longitudinal movement of the bar is controlled by a feed mechanism which permits the amount of feed per revolution to be varied. Provision is also made for the rapid adjustment of the bar in or out by the hand-wheel *G*. Facing arms *H* may be attached to the bar on either side of the cylinder for facing the flanges after the boring operation. The turning tool is fastened to the slide *J* which is fed outward a short distance each time the star-wheel *K* is caused to turn by a stationary pin against which it strikes.

When setting a cylinder which is to be bored it should, when the design will permit, be set true by the outside of the flange, or what is even better, by the outside of the cylinder itself, rather than by the rough bore, in order that the walls of the finished cylinder will have a uniform thickness. The last or finishing cut, should invariably be a continuous one, for if the machine is stopped, even for a short time, there will be a ridge in the bore at the point where the tool temporarily left off cutting. This ridge is caused by the cooling and the resulting contraction and shortening of the tool during the time that it is stationary. For this reason, independent drives for boring machines are desirable. The position of large cylinders while they are being bored is an important consideration, the disregard of which has often caused trouble. Such cylinders should be bored in the position which they will subsequently occupy when assembled. For example, the cylinder of a horizontal engine should be bored while in a horizontal position, as the bore is liable to spring to an oval shape when the cylinder is placed horizontal after being bored while standing in a vertical position. If, however, the cylinder is bored while in the position in which it will be placed in the assembled machine, this trouble is practically eliminated.

There is a difference of opinion among machinists as to the proper shape of the cutting point of a boring tool for finishing cuts, some contending that a wide cutting edge is to be preferred, while others advocate the use of a comparatively narrow edge with a reduced feed. It is claimed that the narrow tool produces a more perfect bore, as it is not so easily affected by hard spots in the iron, and it is also pointed out that the minute ridges left by the narrow tool are an advantage rather than a disadvantage, as they form pockets for oil and aid in the matter of lubrication. It is the modern practice, however, to use a broad tool and a coarse feed for the finishing cut which is, of course, always right. When boring with machines which are equipped with bars not sufficiently rigid, the tool face will have to be made narrower than would otherwise be necessary, to avoid chattering.

* * *

FULTON EXHIBIT, ENGINEERING SOCIETIES BUILDING

The Hudson-Fulton celebration is essentially a recognition of the explorer and the engineer. To show the relation of the latter to the celebration, models of the *Clermont* and other early steamboats, through the courtesy of the Smithsonian Institution, are now on exhibition at the rooms of The American Society of Mechanical Engineers in the Engineering Societies Building, 29 West 39th St. The exhibit includes the *Clermont;* the *Phoenix*, built by John Stevens; and one of John Fitch's early types. Original drawings by Fulton, an oil portrait of Fulton painted by himself, Fulton's dining table, oil portraits and a bronze bust of John Ericsson, models of the *Monitor*, all owned by the society, and Ericsson's personal exhibit at the Centennial Exposition, are also exhibited. Through the courtesy of the Hamburg-American line, a beautiful model of the *Deutschland* shows the highest type of the development of steam navigation.

The model of the *Clermont* represents the boat as she was on her first trip before undergoing alterations to fit her for regular passenger service. The model of the *Phoenix* shows that boat at the time of making the first sea voyage ever made by a steam vessel. The trip was made in 1809, leaving New York on June 8 and arriving in Philadelphia on June 17. Fitch's boat was built in Philadelphia in 1786 and successfully tried on the Delaware River. In 1790 a similar boat carried passengers and freight on the Delaware River for several months.

The exhibition will be open to the public every week day from 9 a. m. to 5 p. m.

* * *

Further experiments in wireless telephony recently carried out in France proved it possible to exchange messages for several hours over a distance of 155 miles. It is proposed to extend the distance, due to the success already attained.

*With Shop Operation Sheet Supplement

THE SPINNER VARIABLE SPEED INDUCTION MOTOR

On the occasion of the joint summer meeting of the Institution of Engineers and Shipbuilders and the Northeast Coast Engineers and Shipbuilders, in Scotland, the works of Messrs. Mavor & Coulson, Ltd., Glasgow, were opened and among the interesting novelties a three-speed 5 H.P. spinner motor was shown in operation illustrating the method of speed control for electric ship propulsion. The spinner motor, which is illustrated assembled and disassembled in Figs. 1 and 2, is an interesting example of the most recent development in the direction of variable speed induction motors. Although the spinner motor has been upon the market for some time, it is not so well known as more commonly used types, and a description of the machine exhibited, will undoubtedly be of general interest to our readers.

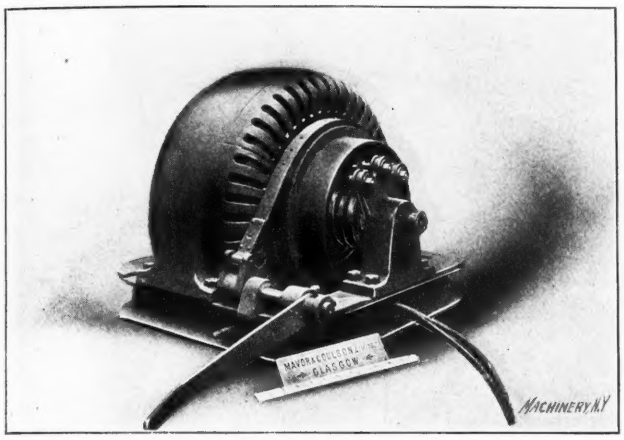


Fig. 1. Mavor & Coulson, Ltd., Variable Speed Induction Motor

There are two elements in the motor which may revolve, these being the ordinary rotor which is mounted on the main shaft, and the spinner. The spinner is cylindrical in form and fits between the annular space between the rotor and the stator. The spinner is carried on end brackets adapted to revolve freely upon extensions of the bearings of the main shaft. A brake wheel is provided on one of these end brackets over which is fitted a metal brake band whereby the spinner can be prevented from rotating when desired. On the outside periphery of the spinner there is a closed circuit or squirrel cage winding, and on the inner surface, next to the main driving motor, there is a winding like that on the stator. In order that the current may be supplied to this winding it obviously is necessary to connect the terminals through slip or collector rings. Both windings on the spinner are placed in slots in the usual manner.

It will be seen from the foregoing description that the machine consists of two motors concentrically arranged around the common axis. Starting from the outside and taking each part separately we first have the ordinary stator winding and then there is the closed circuit or squirrel cage winding on the spinner which together with the stator constitutes one motor. Next on the same spinner there is a winding which only differs from the stator winding in that it can revolve and that its ends are connected to slip rings. Lastly there is a squirrel cage motor mounted on the main shaft and revolving inside the spinner. The current is delivered from an outside source to the primary winding of the fixed stator and spinner respectively, passing in each case through a simple reversing switch.

To illustrate the action of the spinner motor it may be assumed that the primary winding on the spinner is wound so as to give four pairs of poles and that the stator proper of the other or outside motor is provided with eight pairs of poles. If, now, a brake is applied to the spinner and current at a periodicity of 25 cycles be supplied to the primary winding through the collector rings, the speed of the rotor and consequently the driving shaft (if we neglect the slip) will be 375 revolutions per minute. If the stator winding of the other motor with its eight poles be connected in circuit and the spinner simultaneously released, the latter can be made to revolve in the same direction as the main motor, or in a reverse direction. The direction is determined by the reverse switches. Now, since the outside stator has eight pairs of poles the synchronous speed of the spinner can be only 187.5 revolutions per minute, and it is evident that according to the direction of the rotation of the spinner this speed can be added to or subtracted from the 375 revolutions per minute of the rotor obtained when the spinner is held stationary. If, then, the switches are closed so that the spinner revolves in the same direction as the main motor the shaft speed becomes $375 + 187.5 = 562.5$ revolutions per minute. If the reversing switches are closed so as to cause the spinner to revolve in the opposite direction to the motor, then the lowest shaft speed is obtained, or $375 - 187.5 = 187.5$ revolutions per minute.

From the foregoing it is seen that this induction motor has three speeds which are obtained without the use of resistance in the rotor circuit and without varying the periodicity of the main circuit, and without pole-changing in the ordinary sense.

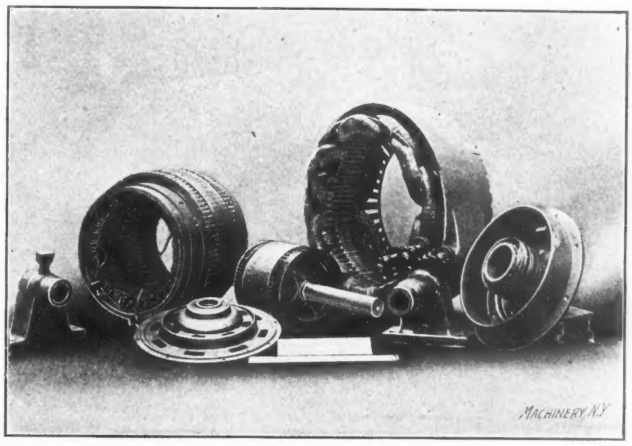


Fig. 2. Mavor & Coulson Variable Speed Induction Motor Disassembled

Fig. 3 shows an interesting application of the spinner motor, wherein it is employed for starting purposes and not for speed regulation. By the use of the spinner, the motor may be started without the employment of resistances or an auto-transformer, and the load may be taken up gradually and without jerks, which is of great importance with colliery haulage gears, etc.

A simple switch is all that is required to manipulate. The rotor which is of the squirrel cage type is coupled to the driving shaft of the haulage gear. The spinner which encircles the rotor, and which is free to revolve when the brake is released carries a three-phase winding. The current is supplied to the collector rings of the spinner and at the moment when the gear is switched on, the hand brake is off so that the spinner is free to revolve. Now, if the spinner is free to revolve, it is evident that so long as the brake is off there is no tendency for the rotor to revolve, for in order to turn, it must exert a torque to overcome the load to which it is mechanically connected. If, however, the brake is applied so as to gradually stop the spinner, the rotor works up to speed and drives the haulage gear. This device may also be employed for reducing the speed of haulage when required.

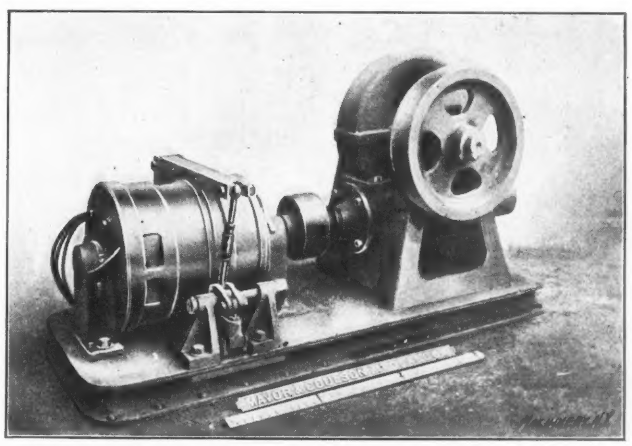


Fig. 3. Application of One-speed Spinner Motor to Haulage Gear

DRAWING DIES FOR HOLLOW RIVETS

CHARLES WESLOW*

One day I stood in the doorway of a large factory "rubbering," when the boss came along and inquired of me if I wished to see anyone in particular. "No," I replied, "I am a toolmaker, and have just come from a neighboring shop looking for a job, and in passing I stopped to see what was going on in the building where I happened to learn my trade." "You learned your trade here?" he asked. I assured him that I did, but that I had been apprenticed to a concern which previously occupied the building, but which had since gone bankrupt. "Well!" he said, "if you are a toolmaker, I'd like you to come into the office." I went in with him, but under

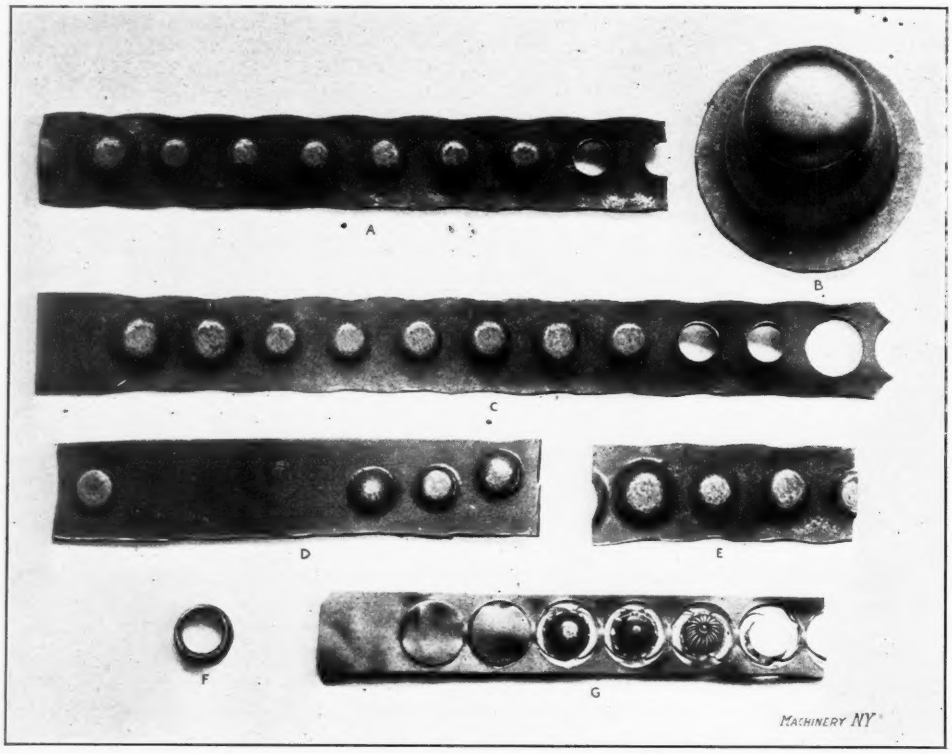


Fig. 1. Samples showing the Results obtained by both the Smooth and the Stepped or Roughed Punches

the impression that he probably knew of a place where I could get a job. Instead, he handed me a sample string of hollow rivets, such as those shown at *A* Fig. 1, which had just come from the die, and asked me if I thought they could be drawn out longer. An idea as to how this could be done instantly struck me, and as it would not be expensive, I was quite prompt in assuring him that the rivets could be lengthened without difficulty. He asked me if I would take the job fixing up the dies, or making new ones, and guarantee that the rivets would come a sixteenth of an inch longer. I told him that I would if it was worth while. He then asked me, with an air of incredulity, if I would do it on contract, and as I assented, he gladly agreed to pay me fifty dollars for the job, remarking that he had already spent about two hundred dollars on those dies, but to no avail. Before leaving to go home for my "kit" he remarked that all their "store" dies and presses gave pretty good satisfaction, except this gang die for rivets, the punch of which would break through before the work even reached the third operation.

I reported the following morning and after examining the work of the dies in question, and watching their movements for awhile, I took down the set, and decided to change the shape and size of the second and third dies and punches. Fig. 2 shows the construction of the punches and dies as they were, each alternate die being shown in section. *K* indicates the "knock-outs." The stripper is not shown. Fig. 3 shows the changes made in both the punches and dies.

These dies were laid out to make two rivets at one throw. In Fig. 2 the order of the various operations, as originally performed, are indicated by the numbers there given. In the first operation a boss is created, the size of which is found by experiment (in some shops this is called "finding" the blank). The punches and dies number 2 then work this boss into a conical shell. The third operation was evidently intended to reduce the diameter of the cone, which was then converted by the next set of dies into a straight shell. The bottom was then cut out by set number 5, while the next and last dies blanked out the finished rivet. This die failed because the punches would break through the bottom of the shell before the latter was completed.

While I knew from experience just what was wanted, I really couldn't go right ahead and fix the dies in a couple of hours, and then have the nerve to ask for the "fifty." So, after much trying to conceal my zest and knowledge, I decided to "kill time" by doing "government work," as some of my own equipment needed repairs. After tinkering around four days, the boss came around and asked me, again in an incredulous manner, if I was confident of success. "Yes," I said, "as far as the dies are concerned," but I added that I didn't know how I'd manage to collect the "fifty." (I really wondered if he would pay it.) "Well," he said, "if you make those dies work in a week, you'll get besides your fifty dollars the price of a pleasant evening with your best girl. So, spurred on by this prospect, I decided that I would make one week the limit and then collect.

By referring to Fig. 3 the changes made in operations numbers 2 and 3 may be seen. It will also be noted that the original operation number 4 is omitted. Instead of making any alterations concerning the location of the fifth and sixth operations, I merely removed the number 4 dies and punches from the press, leaving it to the boss to decide about renewing the whole set, by his own die-maker, since my work ended as soon as I could demonstrate the style of die to use. Therefore the fourth operations on the string *A*, Fig. 1, are merely dummies in string *C*, which is a product of the dies after I had changed them. The stock used was number 18 of the cheapest cold roll that could be bought, but it made no difference how cheap the metal was when it was drawn by the improved method. The original dies, however, only worked successfully on good stock.

In another factory I have also seen the same trouble on brass shells, such as shown at *B*, Fig. 1. In this case the punch should simply have been made rough. I also happened to be poking in the junk pile, and picked up the piece shown at *D*. While I made no inquiry as to its origin, I did keep it as a keepsake, inasmuch as it showed someone's experiments on the same problem as the hollow rivets. This die-maker also got "stuck," since the punch broke the bottoms as shown in the engraving.

Referring to the particular style of punch I substituted for the third operation (see Fig. 3), it can be readily understood that as the punch is irregular in size it has a tendency to imbed its shoulders into the side of the shell, thus pulling the stock into the die as well as pushing it in, and distributing the strain throughout all parts of the shell. Of course this reduces the thickness of the stock on the sides, but when I showed the boss my sample he said that it was good enough for the purpose and just what he wanted. It might be well to explain that the steps on these punches are shown exaggerated in the illustration.

Fig. 4, at *A*, shows an end view of the string *E*, Fig. 1, with the finished shell sawed in half. This sectional view shows the shape of the shell after it is drawn by the stepped punches. Nothing could be done, however, until the die and punch for the second operation were properly formed, as shown in Fig. 3, where they are shown nearly straight. An-

* Address: 332 Jersey St., Harrison, N. J.

other mistake my predecessor made was in continuing the conical shaped die until the fourth operation was reached, and then changing to a straight die. The new die, as will be seen, begins in the second operation to form a nearly straight shell out of the conical boss, and then in the third the stepped punches are applied as previously described. If it were necessary to produce a still longer rivet, the first operation would need to be changed so that there would be a larger boss, and the whole gang would need to be separated more. Figs. 1 and 4 at *F* and *B*, respectively, show a rivet made by the improved dies, slightly curled over to prove its pliability after the stretch.

At *G*, Fig. 1, is shown a sample of a string of brass ornaments as they were manufactured in a fancy goods factory

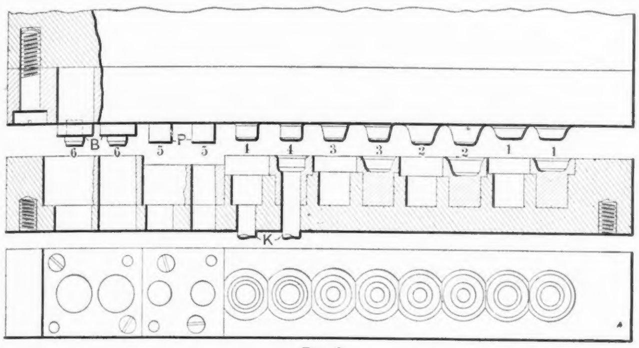


Fig. 2

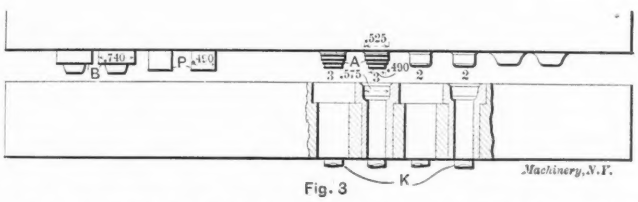


Fig. 3

Fig. 2. Punch and Die in which the Piece shown at A, Fig. 1, was formed. Fig. 3. Improved Punch and Die with Stepped Punches

I had been with. In this case the job is similar to the rivets, because they are also knocked out on a progressive die, but they are pointed cup-shape and easier to form. The first operation is to nearly cut the blank, leaving enough stock to keep it connected with the ribbon, in order to facilitate handling it. Six dies are used: the first and second to nearly blank out; the third to form a cup; the fourth to "coax" the cup to a point; the fifth to corrugate it and further its point, and the sixth to cut it through and trim it.

It may interest some readers to know that taper shells made of brass, silver or aluminum are made just the reverse

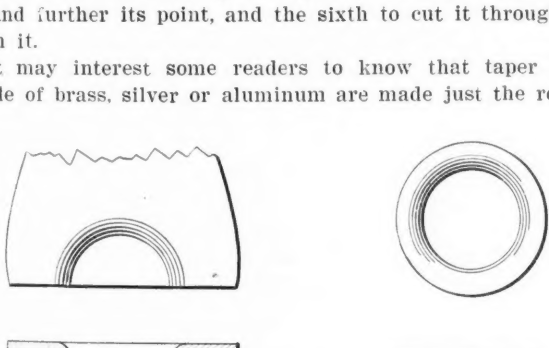


Fig. 4. Sectional View of Drawn Rivet Shell, showing marks left by Stepped Punch

of the way the improved dies described in the foregoing make hollow rivets. The shells are first drawn to the shape of a cone pulley, the number of steps depending on the length and taper of the shell. The corners of the steps are left rounded. This irregular sized shell is then placed beneath a drop-press containing a punch and die having the required taper, and it is "ironed out." The punch is prevented from sticking in the die by an adjustable collar that strikes the die harder than the taper punch. This collar is made in the form of two lock nuts.

SELDEN PATENT UPHELD

Decision was filed in the United States Circuit Court for the Southern District of New York, by Judge Hough, September 15, sustaining the famous Selden patent on gasoline automobiles. The decision holds that the claims of the Selden patent, on which suit was brought, are valid and infringed. The suit is that of George B. Selden and the Electric Vehicle Co., against the Ford Motor Co., C. A. Duerr & Co., O. J. Gude Co., John Wanamaker and others, Société Anonyme des Anciens Etablissements, Panhard, Levassor, Andre Massenat, and Henry and A. C. Neubauer. The decision is voluminous, reviewing the entire case and concluding that the invention of George B. Selden is a pioneer invention of great merit. It holds that Mr. Selden is first in this art and broadly construes claim 1 so that it covers all gasoline automobiles. Claim 1 reads as follows:

"The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprising one or more power cylinders, a suitable liquid fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described."

The Selden patent No. 549,160 was granted November 5, 1895, and, therefore, expires in 1912. The remarkable feature about this patent aside from its broad claim is that the application was filed in the Patent Office May 8, 1879, and the application was kept alive during that period by the technicality of the patent laws, which allow applications to be renewed year by year provided an amendment is made when the new application is filed.

George B. Selden was a lawyer in Rochester, N. Y., during the seventies and spent his spare time experimenting with horseless carriages. After six years of hard work and the construction of five or six different engines he produced a carriage that would run, and finally applied for a patent on the same, submitting a model which is still in the Patent Office. (See MACHINERY, May, 1903.)

The American automobile manufacturers who will not be adversely affected by the decision are the licensees comprising the Association of Licensed Automobile Manufacturers, as follows:

American Locomotive Co., Apperson Bros. Auto Co., Autocar Co., Buick Motor Co., Cadillac Motor Car Co., Chalmers-Detroit Motor Co., The Columbia Motor Car Co., Corbin Motor Vehicle Corp., Elmore Mfg. Co., Everitt-Metzger-Flanders Co., H. H. Franklin Mfg. Co., Haynes Auto Co., Hewitt Motor Co., Hudson Motor Car Co., Knox Auto Co., Locomobile Co. of America, Lozier Motor Co., Matheson Motor Car Co., Packard Motor Car Co., Peerless Motor Car Co., The Pierce Arrow Motor Car Co., The Pope Mfg. Co., Royal Tourist Car Co., Alden Sampson, 2nd, Selden Motor Vehicle Co., F. B. Stearns Co., Stevens-Duryea Co., Studebaker Auto Co., E. R. Thomas Motor Co., Toledo Motor Co., Walter Automobile Co., Waltham Mfg. Co., Winton Motor Carriage Co.

Representative of defendant automobile makers assert that the decision will not affect their business, and that the case will be carried to the Circuit Court of Appeals, and if necessary to the Supreme Court.

* * *

According to *Frankfurter Zeitung*, the German railways occupy the leading position among the railways of the world in regard to safe traveling. The following figures apply to the year 1907 and give the number of passengers killed and injured per million passengers:

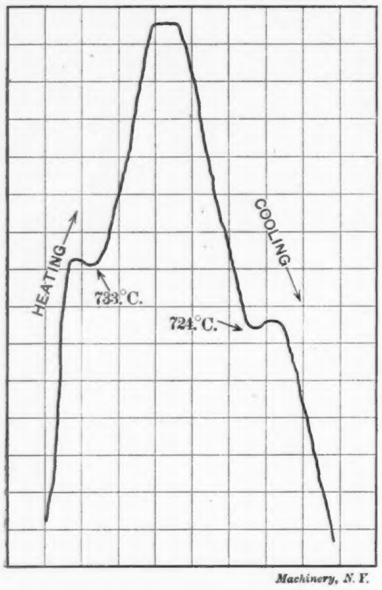
	Killed	Injured
Germany	0.08	0.39
Austria-Hungary	0.12	0.96
France	0.13	1.18
England	0.14	1.94
Switzerland	0.20	1.04
Belgium	0.22	3.02
United States	0.45	6.58
Russia	0.99	3.93

In Germany ninety-two per cent of the railways are owned and operated by the government.

RECALESCENCE AND ITS RELATION TO HARDENING

J. E. STOREY*

Everyone interested in the hardening of steel will have noticed the increasing frequency with which reference is made to the recalescence point of steel, in articles appearing in the technical press from time to time. It is only during the past few years that this peculiarity in steel has come to the front, and there are still very many who do not possess even a rudimentary knowledge of the subject. The somewhat obscure references one usually sees in articles on hardening will not help the man in the hardening shop very much to a better understanding of the matter, and therefore an elementary explanation of the phenomenon will be welcome to many. It may be quoted that, as a matter of history, hardening has been done with more or less success, from the days of the famous Damascus swords up to only a comparatively short time ago, without anyone having discovered that steel possessed such a peculiarity as recalescence, but nevertheless its relation to hardening has always existed, and its discovery paved the way for much scientific investigation into a subject that had been previously controlled by rule of thumb.



Curve made by a Recording Pyrometer, showing the Recalescence Points

The "recalescence" or "critical points" (also sometimes designated Ac. 1 and Ar. 1) that bear relation to the hardening of steel, are simply evolutions that occur in the chemical composition of steel at certain temperatures during both heating and cooling. Steel at normal temperatures carries its carbon, which is its chief hardening component, in a certain form—pearlite carbon to be more explicit—and if heated to a certain temperature a change occurs and the pearlite carbon becomes cementite or hardening carbon. Likewise, if allowed to cool slowly, the hardening carbon changes back again to pearlite. The points at which these evolutions occur are the recalescence or critical points, and the effect of these molecular changes is to cause an increased absorption of heat on a rising temperature and an evolution of heat on a falling temperature. That is to say, during the heating of a piece of steel a halt occurs, and it continues to absorb heat without appreciably rising in temperature, at the recalescence point, although its immediate surroundings may be hotter than the steel. Likewise, steel cooling slowly will, at a certain temperature, actually increase in temperature although its surroundings may be colder.

The accompanying illustration shows a curve, taken on a recording pyrometer, in which the recalescence points are well developed. From this it will be seen that the absorption of heat occurred at a point marked 733°C on the rising temperature, and the evolution of heat at 724°C on the falling temperature. The relation of these critical points to hardening is in the fact that unless a temperature sufficient to produce the first action is reached, so that pearlite carbon will be changed to hardening carbon, and unless it is cooled with sufficient rapidity to practically eliminate the second action, no hardening can take place. The rate of cooling is material and accounts for the fact that large articles require to be quenched at higher temperatures than small ones.

A very important feature is the fact that steel containing hardening carbon, *i. e.*, above the temperature of recalescence, is non-magnetic. Anyone may demonstrate this for himself by heating a piece of steel to a bright red and testing it with an ordinary magnet. While bright red it will be found to have no attraction for the magnet, but at about a cherry-red it regains its magnetic properties. This feature has been taken advantage of as a means of determining the correct hardening temperature, and appliances for its application are on the market. Its use is certainly to be recommended where no installation of pyrometers exists; the only point requiring judgment is the length of time an article should remain in the furnace after it has become non-magnetic. This varies with the weight and cooling surface, but may be tabulated according to weight, leaving very little to personal judgment.

It is difficult to quote reliable temperatures at which recalescence occurs, as the observation of different investigators do not show concordant results, probably owing to the lack of uniformity in the means of measuring the temperatures. It varies with the amount of the carbon element contained in the steel, and is much higher for high-speed than for ordinary crucible steel. Special electric furnaces are generally used for obtaining recalescence curves, but with care it can be done in an ordinary gas furnace, with a suitable pyrometer. All that is necessary is to bore a blind hole in a piece of the steel to be treated, to form a pocket to receive the end of the pyrometer. This must be of sufficient length to cover the resistance coil in the end of the pyrometer. The specimen should then be put in the furnace, with the pyrometer in, of course, the gas applied, and, if the furnace is allowed to heat up very slowly toward a temperature of say 750° C., the recalescence curve will be developed, if the pyrometer is a recording one. In the same way, if the furnace is allowed to cool slowly it will be seen that at the second recalescence point, the specimen gives off heat and even increases in temperature for a time. Experiments of this kind are scarcely practicable for the average hardening shop, but when it is desired to find the lowest hardening temperature for a piece of steel, the magnet can be used to advantage.

* * *

BRASS SPIRALS MADE ON SCREW-CUTTING MACHINE

The illustration shows four brass spirals supplied to the United States government by the Screw Cutting Company of America, 17th St. and Sedgley Ave., Philadelphia, Pa. The spirals were made by cutting a 1½-inch pitch thread, ¼ inch wide, on hard drawn seamless brass tubing 3¾ inch diameter,

Brass Spirals made from Tubing by the Screw Cutting Co. of America for the United States Government

No. 18 British wire gage (0.049 inch). The spirals are used for reinforcing hose, and the longest was cut from a brass tube ten feet long. The company was able to do this work rapidly and efficiently on its special screw cutting machines (see MACHINERY, April, 1909, for illustrations of products), and is prepared to produce similar work in brass, steel or other metal, and on any length of tubes that can be made and shipped. It is of the opinion that the proposition by any other process than its own would have been very difficult and costly.

* Address: 51 Princess Road, Leicester, England.

LETTERS UPON PRACTICAL SUBJECTS

Articles contributed to MACHINERY with the expectation of payment must be submitted exclusively

ACCURATELY LOCATING WORK ON THE FACE-PLATE

The object of this article is to show how easy it is to accurately locate work on the face-plate by the use of plugs and size blocks. The way in which the casting shown in Fig. 1, which is part of the milling fixture, Fig. 5, is located on a lathe face-plate so that it may be bored central with the end bearings, will be explained. By this method all chances of error which might occur in trying to center such a casting in the old way are eliminated. The function of the casting, when in the assembled fixture, is to hold the part shown in Fig. 4 while a groove *G*, 1/16 inch wide and 1/32 inch deep, is being milled on the inner surface, which is spherical. As this groove must have the same depth at each end, the reader will readily see the importance of accurately locating the

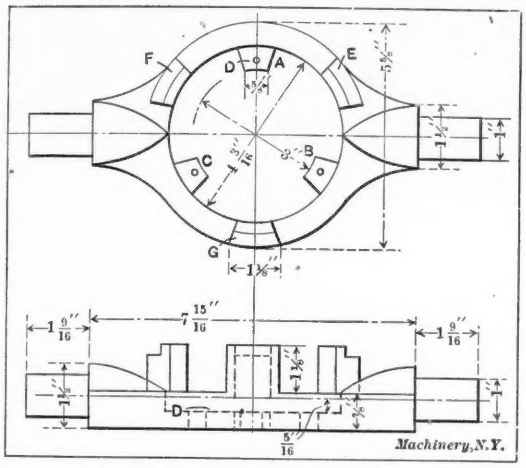


Fig. 1. Work to be Located with Reference to the End Bearings

fixture casting for the boring operation. A plug *A*, exactly one inch in diameter, was first inserted in the lathe spindle as shown in Fig. 2. The two V-blocks, also shown in this engraving, are used on regular tool work, and when made were planed accurately to 1⅝ inch wide, 1⅝ inch long, and 1⅝ inch from the bottom to the center of a one inch plug placed in the V. The distance, therefore, from the sides to the center of the blocks is 13/16 inch, and as there is a 1-inch plug in the spindle, the block to be used between the plug and the parallel upon which the V-blocks are to rest when

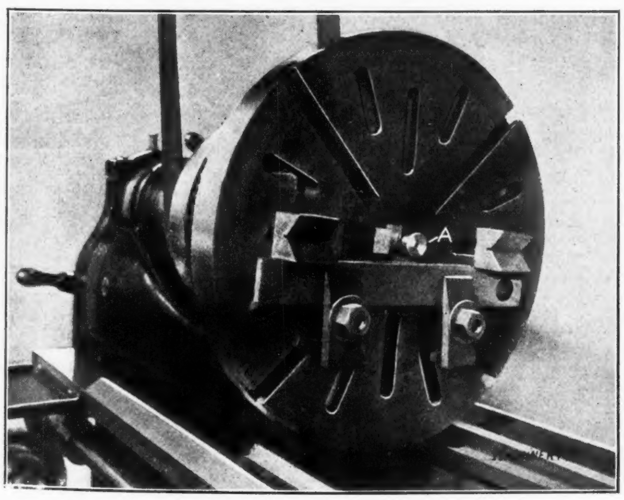


Fig. 2. Setting Parallel and V-blocks from a Central Plug

setting the parallel, would be 13/16 inch minus 1/2 inch, or 5/16 inch. By referring to Fig. 1, we find that the distance between the shoulders of the end bearings is 7 15/16 inches. One-half of this amount is 3 31/32 inches, which minus half the plug diameter leaves 3 15/32 inches, which is the required size of the blocks to be used between the plug and the V-block, only one of which was set in this way. When the casting was placed in the blocks, it was carefully set against the block which had been previously located. The other block was then brought up against the shoulder of the bearing on the opposite end. These V-blocks happened to be tapped in the bottom for a ⅜-inch screw, which, with clamps to hold them against the parallel, made it easy to locate them. The casting was set parallel with the face-plate by the use of a surface gage. Fig. 3 shows the work after the three projections

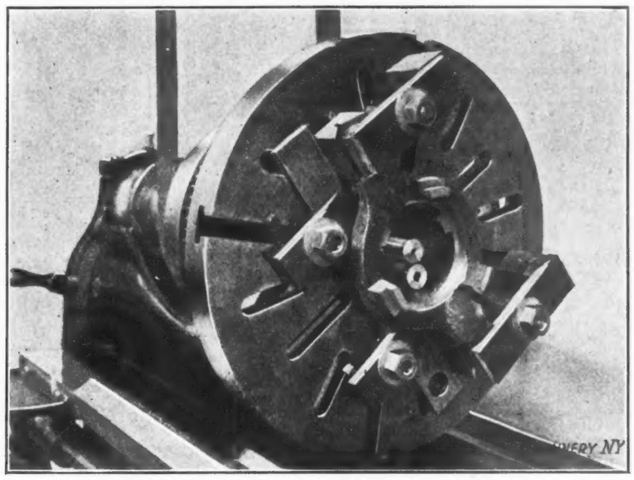


Fig. 3. Use of Central Plug and Ring Gage for Sizing Projections located 120 Degrees apart

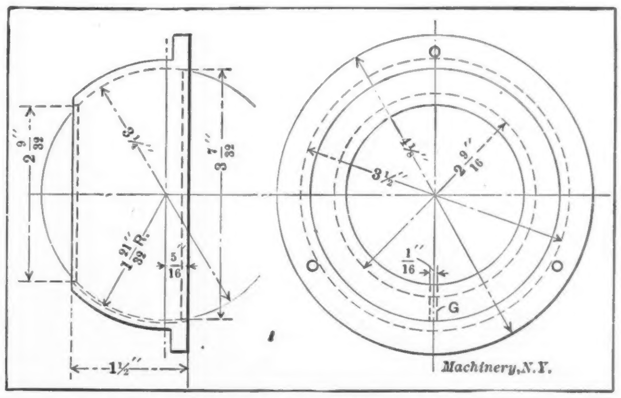


Fig. 4. Casting which is held in the Fixture, Fig. 5, while a Groove is being milled in its Spherical Surface

A, *B*, *C* and the surface *D*, Fig. 1, had been bored and faced. The inner projections were bored to a 3-inch circle by using a standard one-inch ring as a gage (as shown in Fig. 3) which, when placed against the plug, gave a radius of 1½ inch. By referring to the elevation in Fig. 1, it will be seen that the surface *D* must be 5/16 inch below the center line. As the distance from the base of each V-block to the center of a 1-inch plug resting in the V is 1 5/8 inch, 5/16 subtracted from this amount leaves 1 5/16, which is the thickness of the block to set between the point of the tool and the face-plate when setting the tool for the finishing cut. The projections *E*, *F*, and *G* were turned to fit a ring 5 inches inside diameter. A plug was made having one end 3 inches in diam-

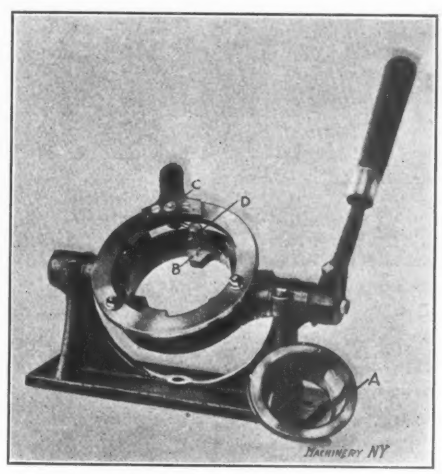


Fig. 5. Fixture of which the Casting shown in Fig. 1 forms a Part

eter to fit the inside of the lugs *A*, *B*, and *C*, Fig. 1, and the other end turned to fit the 3 7/32-inch bore of the spherical casting, Fig. 4. This plug was for locating the piece to be milled so that the pins in the projections *A*, *B*, and *C* would be in such a position that when the work was subsequently located by them, the center of its spherical surface would coincide with the axis of the rotating part of the fixture. Two of these locating pins were also set in a line parallel with the center line of the fixture. All this work was done before removing the casting from the face-plate. It will be understood that if the work should become shifted in any way it can be readily and accurately reset again by this method.

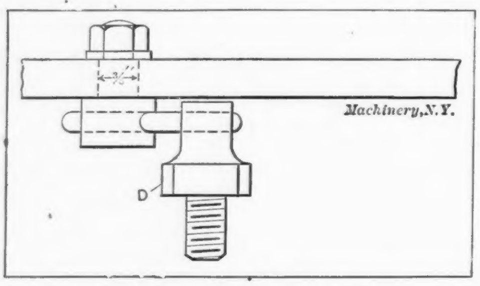


Fig. 6. Detail of Clamping Device for Fixture shown in Fig. 5

The completed fixture is shown in Fig. 5, with a sample of the work held by it at *A*. This illustration, as well as the detail Fig. 6, shows the locking device by which the work is clamped in place. After the casting is located by pins *B* which fit into holes bored in the casting flange, it is secured by a movement of the ring *C* to the right, which causes three locking screws *D* to turn simultaneously, and clamp against the flange. ALBERT C. SAWYER.

Dorchester, Mass.

TWO GAS ENGINE JIGS

In selecting the two jigs shown in the illustrations from among those in use in the manufacture of a well-known gas engine, I have digressed from the usual custom of choosing only the best for description, believing that there is as much to be learned from the mistakes as from the successes. These jigs while embodying some very good features, are offered as examples of jigs possessing points to be avoided.

Fig. 1 shows a piston boring jig. It is a well-designed jig in every respect except one, and that is in the method of clamping the work. This method is the one usually followed for securing cylindrical work, either in a jig or to the drill press table, and it is very effective—so effective, in fact, that more or less work is spoiled by being either cracked or sprung. Gas-engine pistons are necessarily rather light, and to hold them tight enough and still not injure them requires more care than the average operator can be depended upon to exercise. It is almost impossible to avoid springing the pistons, and often they take a permanent set. As an improvement in this and similar jigs I would suggest that the work be clamped longitudinally. This would probably not be as convenient as the method shown, but it should be as effective and certainly would not injure the work.

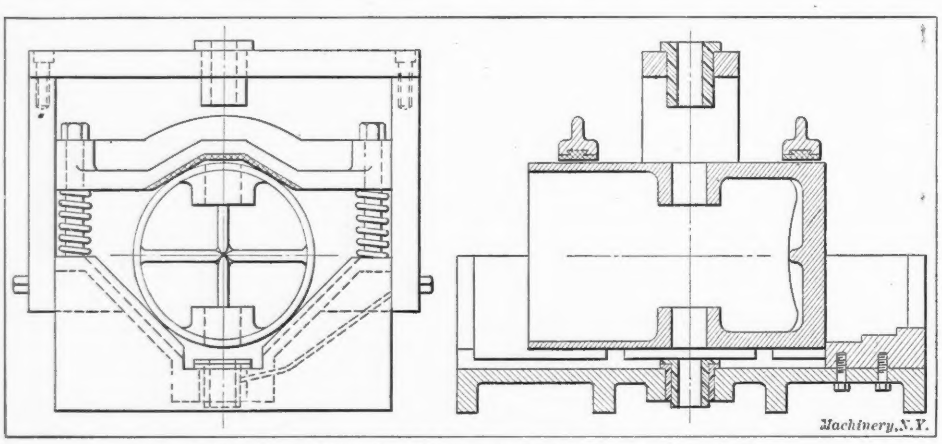


Fig. 1. Elevation and Section of Jig for Piston Boring with Work in Place

A good point of the jig is the springs to hold the clamps up while changing the work. In places where springs can be employed, they will save much time in avoiding the removal of the clamps each time the work is changed. Another good point of this jig is the babbitt metal facing of the clamps, which prevents scarring the pistons.

The fixture shown in Fig. 2 is a chuck for connecting-rods, for use on the milling machine. The method of clamping is quite ingenious, as the turned heads are used both to align and hold the rods. This looks all right on the face of it, but in actual practice it was found necessary to make the addition of adjusting screws under the heads of the rods to prevent them turning on their respective axes under uneven cuts. This added so much to the time of chucking that practically all the advantage gained by the manner of clamping was overcome. J. F. MIRRIELEES.

Cincinnati, O.

CLEANING MICROMETERS

In my travels I have seen many mechanics trying to get emery and grit out of micrometer screws and nuts, either by washing them in benzine, alcohol, kerosene, or other oils, or alkalis, or by digging out the dirt with pine sticks, or pith. At one time mine became clogged with emery, and I sent them to the manufacturer. It cost me 50 cents besides prepaying all charges. When they were returned to me they were worse than ever, so I decided to experiment. I placed the screws in benzine to remove the oil which had been collecting the emery. Then the parts were heated just enough to be held comfortably in the hand, and a coating of beeswax was applied to the screw and nut. The screw was then placed in the nut, after it was cold, which forced all the small particles of dirt out with the surplus wax, and closed up the slots, avoiding the possibility of dirt and emery becoming clogged in them. A small thin coating of wax was therefore left between the screw and nut. The screw was then removed from the nut, and all surplus wax removed, and a drop of thin oil applied. Anybody having trouble with their micrometers will find this remedy O. K. Mine have been in daily use for nearly three years, with the same coating of wax, and are to-day in good condition. FRANK G. STERLING.

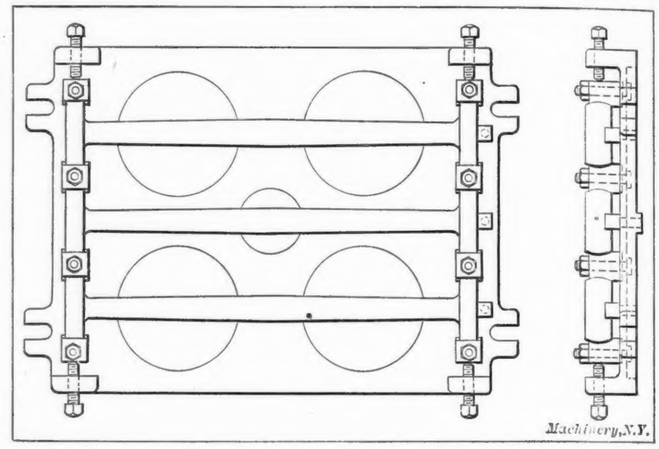


Fig. 2. Design of Fixture for Connecting-rods, which proved Objectionable

Franklin, Mass.

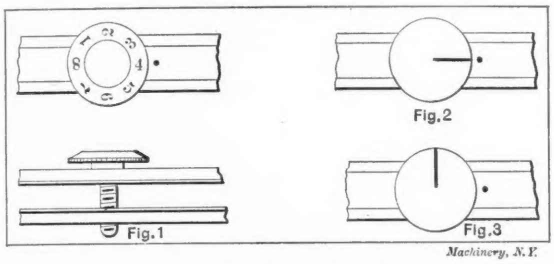
GRADUATED SCREW HEADS ON DRAWING PENS

Having had some difficulty in getting all the lines on a drawing of the same width, it occurred to me that it would be a good scheme to graduate the screw heads of the drawing pens, so they could always be set for some pre-determined width of line before beginning to draw. With this object in view, a bevel was turned on the upper faces of the screw heads which were stamped with numbers from 1 to 8, as shown in the plan view in Fig. 1, and a center punch mark was made on the blade of the pen, against which to

read the numbers. After the different pens in the set of instruments are marked, they can be adjusted by trial on a waste piece of paper until they all draw the same width of line, and a record made of the reading of each screw, as shown in the accompanying table, there being two records for each pen, one of which is for light lines, and the other for shade lines. There is not much use for a shade line adjustment on the compass pens, as nearly all draftsmen

	Small Compass	Large Compass	Straight Line
Light line..............	4	1	7
Shade line..............	6	3	1

shade their circles by springing the needle leg, but it is of occasional use in drawing short arcs. The record shown in the table can be hung up on the wall, placed in the cover of the instrument case, or anywhere that is convenient for reference. As the pens are sharpened, or the screws wear in the thread or under the shoulder, the record for the pen settings will have to be altered at quite long intervals, depending on how much use each pen gets. Some makers supply straight line pens with a graduated screw head somewhat larger than usual, but mine were of the kind that is ordinarily supplied with drawing instruments, and were rather



Ruling-pen Screw-heads Graduated to obtain Lines of Uniform Width

small in diameter, so the numbers were not very large; however, I find it a great help. Anyone not having facilities for stamping numbers can place two ink marks on the screw heads—one red mark for light lines and one black mark for shade lines; or only one ink mark can be used on the screw head, having it point as in Fig. 2 for light lines, and as in Fig. 3 for shade lines. This ink mark scheme is not original with me, as I am indebted to R. A. Gleason for it. The marks will last quite a while, as the ink is on the flat side of the screw head that is not supposed to be handled.

Brooklyn, N. Y. WALTER GRIBBEN.

CHUCKING TRANSMISSION SLEEVES FOR INTERNAL GRINDING

A special steady-rest and chuck for use in the grinder when grinding a certain make of automobile transmission sleeve, is shown in the accompanying illustrations. Fig. 1 shows a

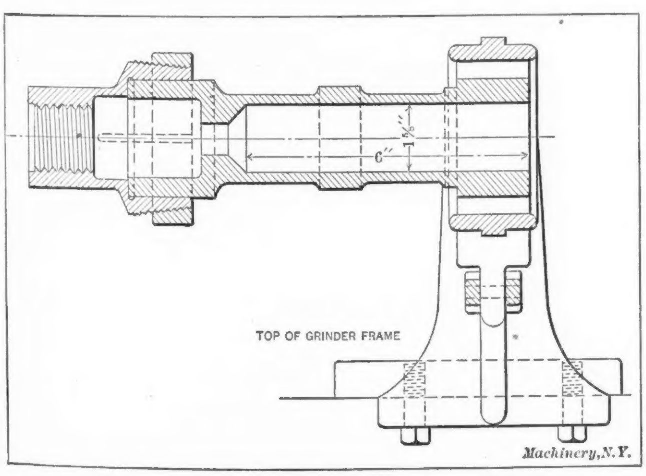


Fig. 1. Plan in Section of Grinder Rest and Chuck with Work in Place

plan view in section of the chuck and rest with the work in place, and Fig. 2 an end elevation. The sleeve, which is a steel drop forging, is finished all over, after which the hole 1⅝ by 6 inches long is ground to fit a plug gage. This method of holding the work enables it to be quickly set so that the hole will be finished perfectly concentric with the outside surfaces. The chuck which holds one end of the sleeve is of the ordinary spring collet type. It has six milled slots, and the chucking end has a taper of 7 degrees

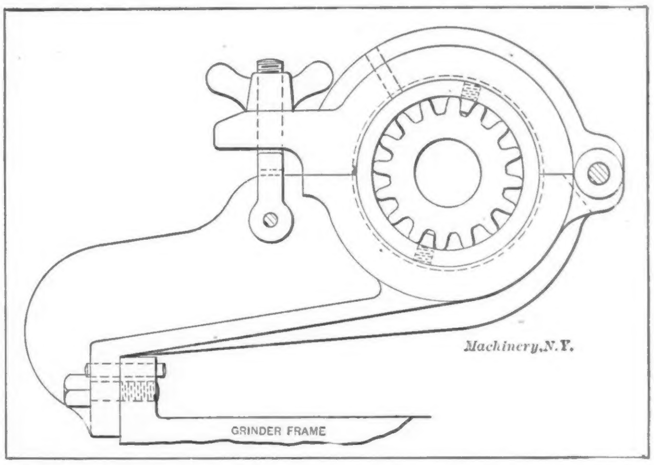


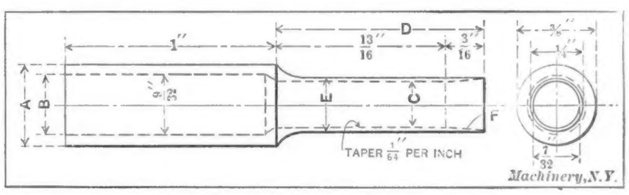
Fig. 2. End Elevation of Rest, showing Method of Holding End of Work

which is threaded. A machine steel ring-nut with holes for a spanner wrench is threaded to fit the taper part of the nut. Both the chuck and the ring are hardened and ground to size. During the grinding operation the outer or gear end of the sleeve is held in a one-piece bronze ring. This ring is provided with a tongue which is a neat working fit in a groove in the steady-rest. As shown in the end elevation, this rest has a hinged cap which is held in place by a hinged clamping bolt provided with a suitable wing-nut. Bolts and dowel pins secure the rest to a rib on the grinder frame. In the bronze ring there are two steel studs which are flush with the outside diameter and which protrude inward as shown in the end view. These studs are shaped to fit the teeth of the gear, thus causing the bronze ring to turn with the sleeve during the process of grinding. With this form of rest, the chucking, grinding the inside of the sleeve, and removing it, is all done in about eight minutes, which is seven minutes less than formerly required. There is also little danger of error because of an unskilled or careless operator, as he cannot make a mistake in chucking the work.

M. HEARTILLHEN.

A DRILL FOR PAPER

The accompanying engraving illustrates a tool which is remarkable for its simplicity and efficiency. This tool was developed in a jobbing shop where tools were being made for loose leaf ledger work. There was considerable trouble with the tools for punching the ledger leaf holes, it being difficult to get the punches to cut "clean," through any considerable thickness of paper, so an attempt was made to drill the holes instead of punching them. It was soon discovered that the paper could not be drilled with any kind of lip drill, because, no matter how the lips were shaped, they would catch and tear the paper. After considerable experimenting, the tool



A Tool for Cutting Holes through Paper

shown in the engraving was developed, and it was found to be far superior to the ordinary method of punching. This tool requires but little explanation. To make it, take a piece of tool steel and catch it in the lathe chuck, allowing it to extend from the chuck far enough to permit of its being turned the full length, and then cut off. Next turn the diameter A allowing 1/64 inch for a finishing cut. Turn down the end to the diameter E, and to the length D, again leaving 1/64 inch for a finishing cut. Now drill through the full length of the

tool, a hole slightly smaller than *C*, so that it may be trued up with the boring tool. Before finishing this hole, bore out the clearance hole *B* which should be 1/16 inch larger than *C* to allow the scrap or paper cuttings to pass through freely. Next finish the hole *C*, making it 1/64 inch per inch taper, the largest part of the hole being at the back. This hole should be 1/32 inch smaller than the outside diameter *E*, which is the exact size of the holes to be drilled in the paper. The diameters *A* and *E* are next finished, *E* being made 0.001 inch smaller at the back than at the cutting end. Taper the mouth of the tool as shown at *F*, bringing it to a fine edge at the outside diameter. The tool may now be cut off and hardened. It should be hardened in oil, and drawn to a dark brown at the cutting edge, this color running off gradually to a blue at the back end of the tool. If care is exercised in hardening, there will be no necessity for grinding or lapping. The tool may be used in the drill press, and it should run about 1,500 revolutions per minute. The press or speed lathe in which the tool is used should have a hollow spindle to allow the paper cuttings to pass through. If, however, a hollow spindle machine is not available, a chuck with sufficient space to permit the cuttings to pass out between the jaws, may be used, or a special holder may be made, of simple design, to serve the purpose. One who sees this tool work for the first time will be surprised to observe how clean and freely it will cut.

C. W. D. and W. B.

ADJUSTABLE ELECTRIC LAMP BRACKET FOR THE SHOP

In many shops it is found to be quite a problem to construct an electric lamp bracket for the bench, which can easily and quickly be adjusted to any height and position. The Cincinnati Shaper Co. uses a bracket which fills the bill and the cost of which is trifling. The illustrations, Figs. 1 and 2, show this bracket assembled and in detail. The same reference letters are used in each illustration for corresponding parts, so that the construction of the bracket may be more easily understood. The small cast iron angle-plate *A* is screwed to the wall. The top of this plate, as shown in the plan view, Fig. 1, is serrated so that the arm to which the lamp is attached, will remain in the desired position. These serrations are cast in, and the only machining done to this

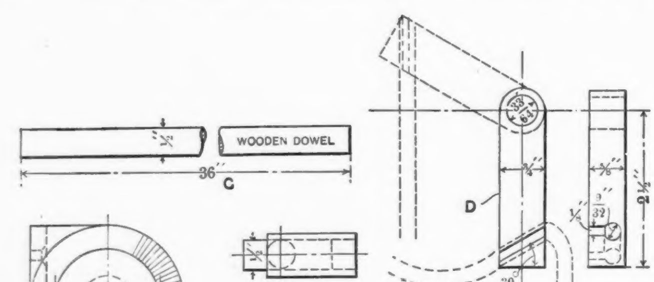


Fig. 1. Details of the Adjustable Electric Light Bracket shown in Fig. 2

piece is the drilling of the screw holes for fastening it to the wall or window sill. The small casting *B*, which is attached to one end of the wooden arm *C*, has a curved end which fits into a hole in *A*. A ½-inch hole is cored into casting *B*, and into this hole the wooden dowel *C*, which is about 36 inches long, is driven. As will be seen by referring to the end view, the casting *B* has a sharp V-shaped projection on the bottom of the front end; this rests in the serrated part of the angle-plate. The piece *D*, located at the end of the arm *C*, is of fiber. This is drilled 1/64 inch larger than *C* to permit it to slide back and forth easily. The hole through which the lamp wire passes is drilled at an angle of 30 degrees, as shown in Fig. 1, to prevent the wire from slipping. A slot is milled into this hole on one side so that

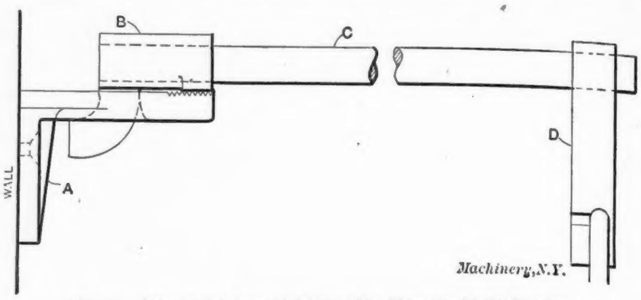


Fig. 2. Simple Design of Adjustable Electric Light Bracket

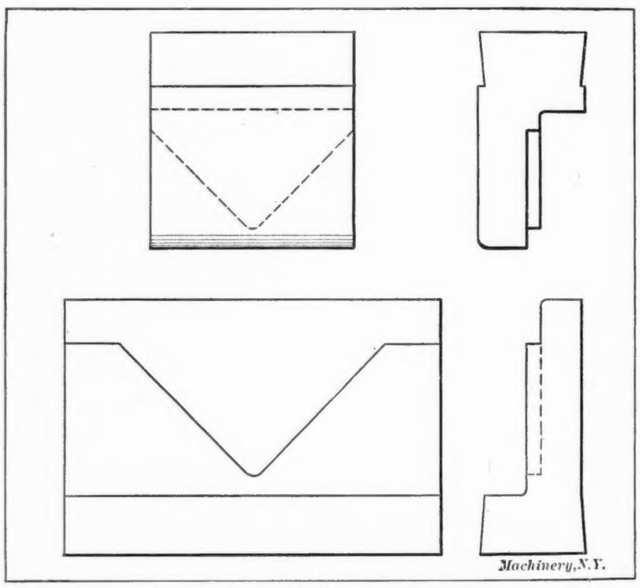
the wire may be placed into position. By raising the block, as shown by the dotted lines, the lamp can easily be adjusted to any height.

H. Donnerberg.

Cincinnati, O.

A BENDING DIE

A type of punch and die that is adapted for bending at right angles, edgewise, soft steel strips, in size from ⅛ × 1-inch to ⅜ × 1-inch, is shown in the accompanying engraving. This tool commends itself from the fact that it is of simple design, easy to make, and that, in bending the stock,



Die for Bending Soft Steel Strips Edgewise

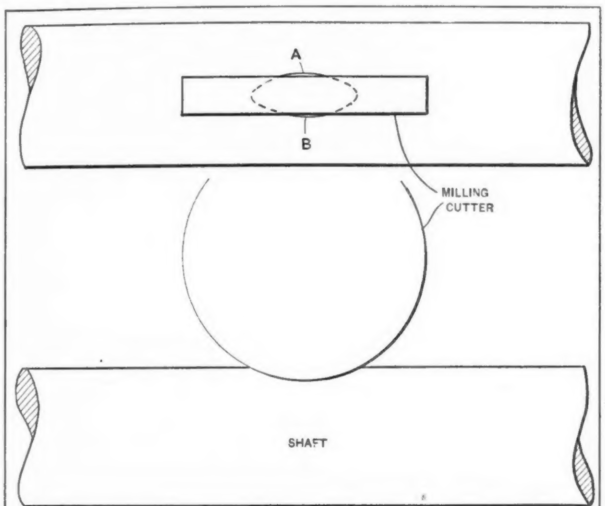
the inner angle does not increase in thickness to any appreciable extent. When accurate work is required and no increase whatever in thickness at the bend is allowed, the punch and die may be locked together by extending a part of the punch over the rear of the die. This will eliminate any tendency of the two members springing away from each other in action. As the stock bent in this die was in long strips and extended beyond the die, a stop (not shown) was attached to the side of the bolster. This tool is run in a press with a stroke of 4 inches. Both the punch and the die are planed at an angle of ten degrees to fit the holder, and they are both hardened.

Engineer.

CENTERING SHAFT WITH MILLING CUTTER WHEN KEYSEATING

The micrometer gage for centering work with milling cutters, described by Mr. Chapman in the July number of Machinery, would do this work with considerable precision were it not for the fact that in the present rush and hurry in manufacturing probably 80 per cent of the milling cutters do not run perfectly true on the arbor; and, in that event, there would be great chance that the accuracy of the micrometer would be useless. Assuming that the cutter runs perfectly true, then undoubtedly the tool referred to is all right

from a standpoint of accuracy; but I fear that in a majority of shops, it would be too fine a tool to suit the foreman, who is naturally supposed to be anxious to do things in a hurry. I recall one such foreman, from whom I received many a good lesson on economy and rapid production, and one of these was on how to locate a shaft with the cutter when milling a spline or key-seat. This method works equally as well on a planer as on a milling machine. After the shaft and the tool or cutter is in place, start the machine and either plane or mill a flat spot across the top of the shaft as wide or a trifle wider than the key-seat; then set the tool by this finished surface. For example, when a shaft is to be set central with a milling cutter, the latter is first sunk into the work as shown in the accompanying engraving. The shaft is then fed crosswise under the cutter and a spot milled as indicated by the dotted lines in the plan view. After this spot is milled a trifle wider than the width of the cutter, the work may be set by sighting down over the top of the cutter and adjusting the work until the same amount of



Method of Setting a Milling Cutter Central with a Shaft

milled space shows at *A* and *B*. The cutter should be revolving while this adjustment is being made so in case it runs out laterally, the high sides will appear at the bottom in such quick succession that it may be set the same as a true running cutter. After the first shaft is located, the operator should not move the cross-feed screw until all of the shafts are finished. Of course, on the planer the locating spot will have to be machined for each shaft. This should not be done by feeding down a broad nose tool, for while any kind of a tool may be used, it must be fed crosswise in order to finish a surface which is parallel with the planer platen. I have used this method for years and find it satisfactory both in regard to time and accuracy. Therefore I pass it along hoping that it may be of help to someone.

Bridgeport, Conn. H. E. Wood.

ACCURATE BORING ON THE HORIZONTAL BORING MILL

Among the standard tools of to-day in most machine shops is found the horizontal boring mill, and although not as old as the lathe, planer, and some others, it is equally as necessary on some classes of work as these older and more standard tools; but in operating this tool the workman generally finds great difficulty in obtaining an accurate hole of a very great length, especially if the equipment, including bars and guide bushings, are not absolutely new, in addition to being accurate. A simple equipment that is generally used is shown in Fig. 1. The bar *A* is made of annealed tool steel, and the cutter *B* is held in a central position by the wedge *C* and a fitting on either side of the bar. The bushing *D* is bored to fit the bar and turned to suit the hole in the yoke of the machine. This bushing is held in the yoke by two set-screws which are spotted into it to prevent any slipping or turning without subjecting the bushing to any great strain. Here lies the chief difficulty to which the writer desires to draw particular attention, and acquaint the reader with a very desirable and successful remedy.

As the bushing is always in the same position, a large portion of the wear comes on the bottom. This wear, in turn, allows the cutter to run closer to the table as it proceeds away from the machine until it reaches the yoke; then the work receives the full benefit of the worn or inaccurate bushing and a hole is produced which is not parallel with the table and of an elliptical shape, the vertical axis being the longest because of the play the bar has in the bushing. Even when the bushing is made a suitable running fit, a hole will show

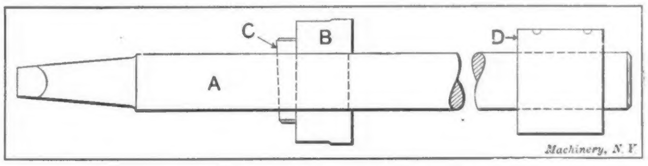


Fig. 1. Boring-bar with Solid Bushing

from one to four one-thousandths difference between the horizontal and vertical axis. From the foregoing it is readily seen that the object required is to maintain the bar in a perfectly central position with the spindle at all times, just enough freedom being provided to allow the bar to turn.

Fig. 2 shows a form of split adjusting bushing which is very old in principle, but which produces excellent results in this case. The outside bushing *A* is turned to suit the hole in the yoke of the boring mill, and it is bored parallel to receive bushing *B* which, in turn, is bored taper to receive bushing *C*, the inside of which is bored parallel to the exact size of the bar. This inner bushing is split in three parts. Two washers or end plates *D* are required, whose bore is 1/16 inch longer than largest bar; these are each secured to bushing *A* by four tap bolts, as shown, and they are also drilled and tapped for two set-screws *E*, which bear against bushing *B*. Two of these set-screws are required on one end for tightening and two on the other for loosening bushing *B*.

The pressure sometimes applied on these set-screws is enough to nearly burnish the bar with heat, when a particularly fine finish is required, so that the allowance for a running fit is reduced to an absolute minimum, and the resulting cut will be just as true as the machine, less the wear of the

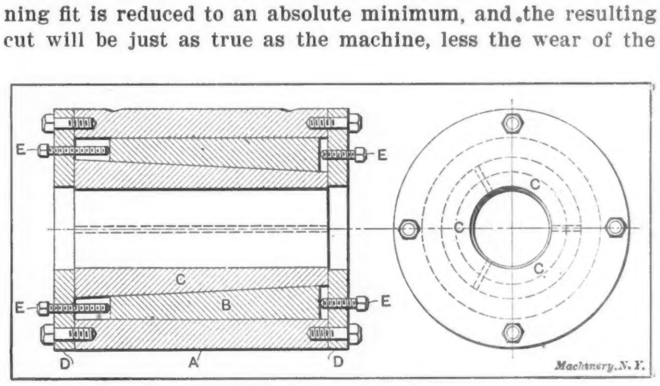


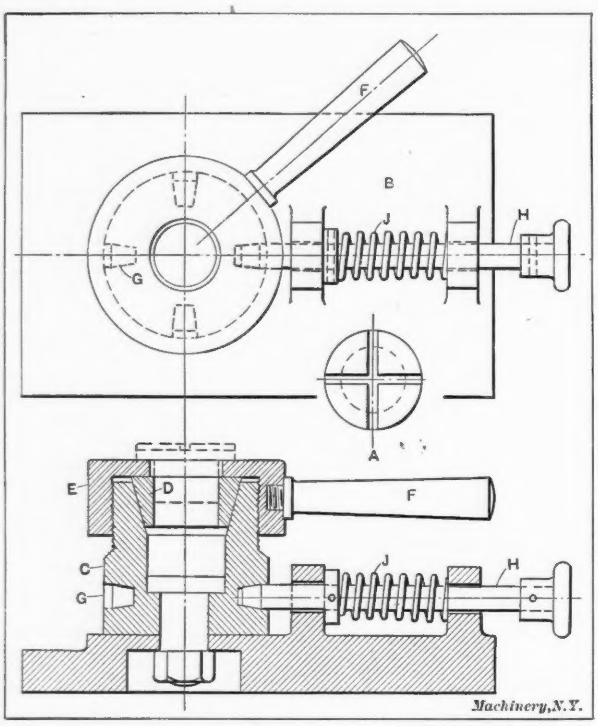
Fig. 2. Split Adjustable Bushing for the Boring-bar

tool, which will vary slightly according to the quality of the steel in the tool compared with the material being cut; when these both agree, accurate work will result. The construction of the device is not confined to any set dimension or taper, but it is preferable that the taper be quite abrupt to obtain quick adjustment, to allow for a large take-up for wear, and to obviate too much of a wedging effect. The different diameters of bars are taken care of by having a number of split bushings *C*, the inside diameters of which correspond with each bar. R. S. F.

MILLING FIXTURE FOR SMALL CYLINDRICAL WORK

A chuck for holding a small plug, a plan view of which is shown at *A*, while grooves are being milled at right angles across its upper face, is shown in the accompanying engraving. This chuck consists of a base *B* which is fastened to the milling table. On this base is pivoted a cylinder *C* which is threaded on the upper end, and turned tapering on the inside to receive a conical bushing *D* which fits the taper of the

cylinder. This bushing is split so as to allow it to be sprung together when forced down by the cover *E* which is threaded to fit the cylinder *C*. This cover is turned by means of the handle *F*. The taper of the bushing and the recess in *C* should be of such an angle that the two pieces will not grip and hold fast. An angle of from thirteen to fifteen degrees is about right. In the lower part of the cylinder *C* there are



Milling Fixture for Holding the Plug shown in the Plan View at A, while the Grooves are being milled

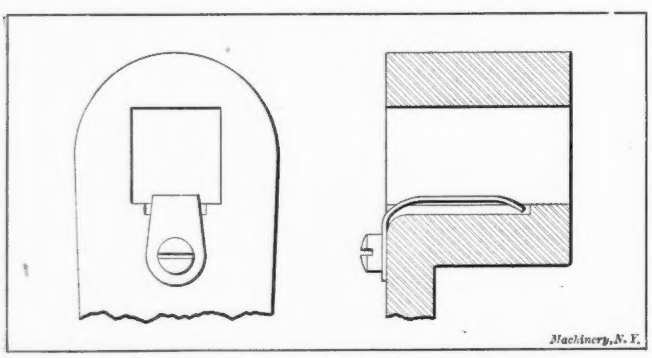
four holes *G* which serve for spacing the cuts. On the base *B* there is mounted a pin *H* which is held in one of the holes *G* by means of the spring *J*.

The operation of the fixture is as follows: By turning the handle to the left, the cover raises and the bushing *D* slips up and expands. The plug is then dropped in place, as shown by the dotted lines, and the handle turned to the right, which forces down the cover *C* and bushing *D*, causing the latter to spring together and grip the plug. A cut is then taken across the top. Then by pulling back the pin *H* and turning the handle *F* to the right until the next hole *G* comes in line with the pin *H* the work is indexed for the next cut. Then the handle is turned to the left again, and the plug released and another inserted.

This chuck could be used for many different kinds of work by having the proper bushings. E. B.

SECURING CRANK HANDLES

The crank handles supplied by many builders with their machine tools, soon find themselves as much at home on the floor as on the squared end of a feed-screw. In the course of



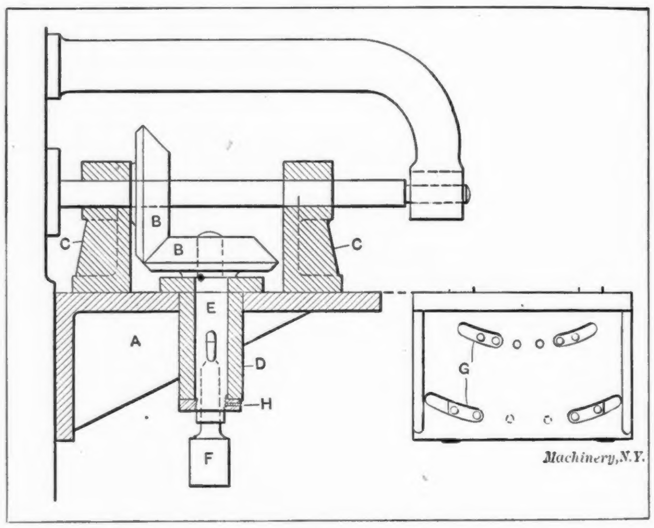
Crank Handle with Pressure Spring which prevents it from coming off

a year, a great deal of time is spent in picking up these fallen handles, to which must be added the cost of new ones to replace those of cast iron which still are sometimes foisted upon us. Half an hour's work will fix any handle so that it will not fall off. As seen by the illustration, a small groove is chipped part way through the hole for the squared end of the screw, and a bent flat spring is fastened to the handle. Unless the handle is very loose on the feed-screw, the spring need bear on the latter with but little pressure to keep it in its place. Then it can be slipped on and off almost as readily as without the spring, when it is necessary to do so to place it in a convenient position.

Middletown, N. Y. DONALD A. HAMPSON.

MAKING A VERTICAL MILLING ATTACHMENT

Much has been done of late years in the way of developing the vertical attachment for milling machines, as this little attachment permits one to do a great variety of work. There are, however, thousands of milling machines in the field today which do not possess one of the model up-to-date vertical attachments, and therefore I shall give a brief description of how one of them was made in a rush one day when the occasion demanded it. As the draftsman and patternmaker both happened to be on a vacation, it fell to me to rig up the attachment with the things I had at hand, which I proceeded to do by retiring to the casting house, where the two brackets *C* and the flanged casting *D* were found. After some more rooting around the shop I dug up an old pair of miter gears that had been discarded from an experimental job. Then, taking one of the regular angle irons *A* away from a planer, I proceeded to lay out and cut the radial slots *G* shown in the end view. These were to allow the vertical



Vertical Milling Attachment made from Miscellaneous Scrap

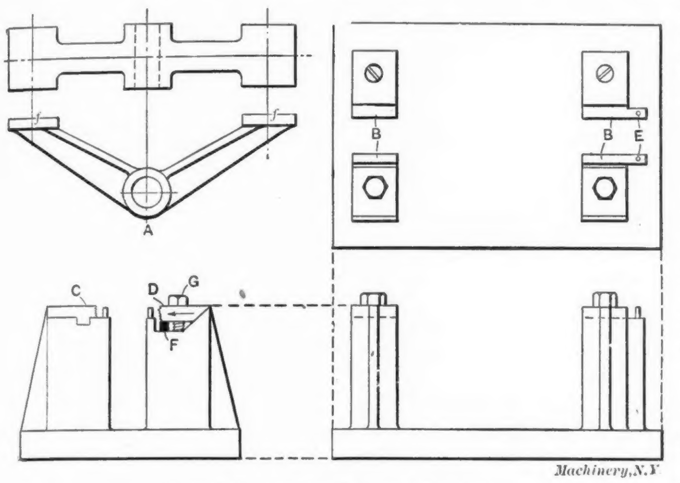
spindle to be tilted. During the time this was going on, another man was boring out and turning the casting *D*, but to no particular size, just enough metal being removed to clean it up. The feet of brackets *C* were also planed. The angle iron *A* was put on a drill press and drilled and bored to a driving fit for bushing *D*. The spindle *E* was next made, from a piece of scrap shaft, to match casting *D* and gear *B*, and then collar *H* was made to suit the spindle. When this was done, we were ready to assemble. To do this it was necessary to drill several holes in this milling machine column, and right here is where many of the machine owners and old-school mechanics would have objected and said: "Don't drill any holes in that machine; every hole you drill knocks $10 from its value if you ever want to sell it." Now let me say to them that a machine is in a shop for the purpose of earning all it can for the owner, and it is not an ornament to be kept nice so that it will sell for $19 more some day. Therefore it is up to the foreman to get all he can out of every machine, but of course he has no right to needlessly destroy it. Then again, in this particular case, the vertical attachment would add ten times more to the value of the machine than the holes could possibly take off. When assembling the attachment a makeshift boring-bar to bore out the castings *C* was used. We had to bore the holes larger and bush them down to match our regular arbor; the gear *B* had also to be bushed down. This article is offered in hopes that it may possibly suggest to someone else a method of getting around some of their milling machine troubles. Of course we know

that vertical attachments usually come now with new machines, but nevertheless there are thousands of milling machines without them, the owners of which do not care to expend the amount of money that one of them costs.

Bridgeport, Conn. H. E. Wood.

A SHAPER FIXTURE

The engraving shows a shaper fixture used for holding the bracket *A* while the feet are being planed, as indicated by the finish marks *f*. This bracket rests upon the surfaces *B*, and it is held in place by jaws *C* and *D*, and the pins *E*, which prevent the thrust of the cut from shifting it endwise. The steel stationary jaws *C* are held in place by a tongue which is re-



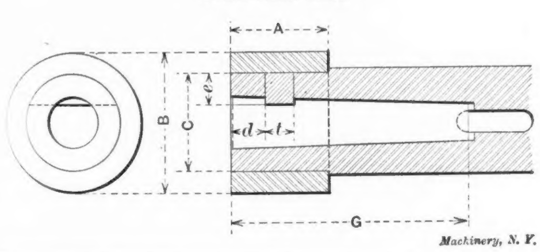
Shaper Fixture for Holding a Bracket

cessed into the jig body, and by the fillister head screws as shown. The steel jaws *D*, which are finished on one end to an angle of 45 degrees, are forced against the work by tightening the cap-screws *G*. The inside ends of the jaws *D* rest upon stationary blocks *F* of solid rubber. Both sets of jaws are hardened, and the working faces are serrated. This forms a very simple but effective way of holding the bracket, as the jaws *D* will have a downward and an inward movement when they are tightened, which, with the serrated faces, will cause the bracket to be gripped firmly. Jig and Tool Designer.

DRIVE FOR DRILLS AND REAMERS

Recently there have come upon the market several devices that are designed to eliminate the tang troubles commonly experienced in connection with the use of Morse standard

DIMENSIONS OF SOCKET AND KEY FOR MORSE TAPER SHANKS WITH FLAT SIDE



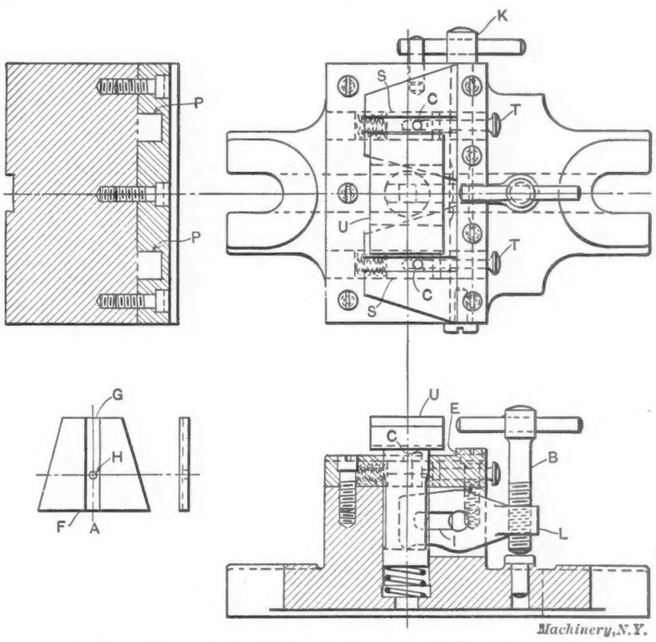
Taper No.	A	B	C	G	d	t	e
1	7/8"	1 1/4"	7/8"	2 1/8"	5/16"	1/4"	9/32"
2	1 3/8	1 3/4	1 3/8	2 9/16	1/2	5/16	7/16
3	1 3/8	1 3/4	1 3/8	3 3/16	1/2	3/8	5/16
4	1 3/8	2 1/4	1 3/4	4 1/16	1/2	3/8	13/32

taper shanks on drills and reamers for severe service. The apparent demand for some method to increase the strength of taper shanks suggests that a device which has been in use for a number of years in the factory where the writer is located, may be of interest. The accompanying engraving and table, taken from the writer's notebook, gives the dimensions of standard Morse sockets fitted with a key, which engages with a flat side on the drill or reamer shank. This key is inserted by milling a slot across the socket near the end, so that the slot will cut through into the tapered bore. A piece of flat steel, or a Woodruff key, is driven tightly into this slot, and then the outside of the socket, including the projecting part of the key, is turned off for a short distance from the end, and a steel collar driven over it. This collar retains the key in place and reinforces the socket. The shanks of the drills and reamers are milled flat on one side so as to fit against this key when driven into the socket. For milling the shanks so they will be interchangeable, master shanks are used, which are put on centers in the milling machine and used to set the milling cutter by. The master shank is then removed and the tool to be milled put on centers and milled with the tool setting obtained from the master shank. The flat on the side of the shank is milled parallel to the axis of the shank. For use in connection with the sockets described, the shanks are made without any tang upon the end, but in all other respects they are made according to the standard Morse tapers. As stated, this device has been in use for a number of years and the results are satisfactory. Bruce C. McAlpine.

Jackson, Mich.

EFFICIENT TYPE OF MILLING FIXTURE

The fixture shown in the engraving was designed to mill the groove *G* in the work which is shown at *A*. This groove is 0.187 inch wide and 0.042 inch deep, and it is necessary that it be central with the hole *H* and at right angles with the face *F*. The fixture was designed to hold two of these pieces at one time. It is composed of a cast-iron base on



Milling Fixture with Efficient Locating and Clamping Devices

the top of which is a steel plate held by fillister-head screws and located by the tongues *P*. These tongues or projections are cut away in the center, and into these spaces are fitted the slides *S* which carry a centering pin *C*, which fits the hole in the work. The slides, by means of the compression springs behind them, force the face *F* of the work against the shoulder *E* thus locating this face at right angles with the feed of the table. When the pieces are being placed over the pins *C*, the slides *S* are operated by the thumb-plungers *T*. The T-clamp *U* holds the two pieces of work, one on each side. It is operated by screw *B* through the lever *L*, and a spring underneath keeps it up when no work is in the fixture. The shaft *K* upon which *L* fulcrums extends through the fixture and it is milled flat on opposite sides at a point where it passes through the lever, to a little less than the width of slot *I*. When this shaft is turned 90 degrees from the position shown, these flat sides are in alignment with this slot and the lever can then be pulled out clear of the clamp so that the latter may be lifted out of the fixture. The advantages of a clamp of this style are that it can be quickly removed, thus making it easy to brush away chips. The milling arbor can also be brought close to the work, thereby allowing the use of small cutters when necessary.

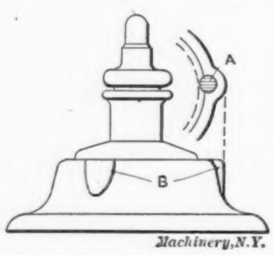
Athol, Mass. W. A. Sawyer.

SHOP KINKS

PRACTICAL IDEAS FOR THE SHOP AND DRAFTING-ROOM

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary

HOLDER FOR THE INK BOTTLE



The ink-bottle holder illustrated in the April number of MACHINERY is very similar to one brought out and patented in Scotland some three years ago, the difference being that instead of using a retaining spring to hold the bottle, round india-rubber inserts are used instead. These rubber retainers are inserted as shown at *A*, the bosses *B* on the side of the base being drilled to receive them.

BOTTLE HOLDER.

SCRIBER FOR SMALL HOLES

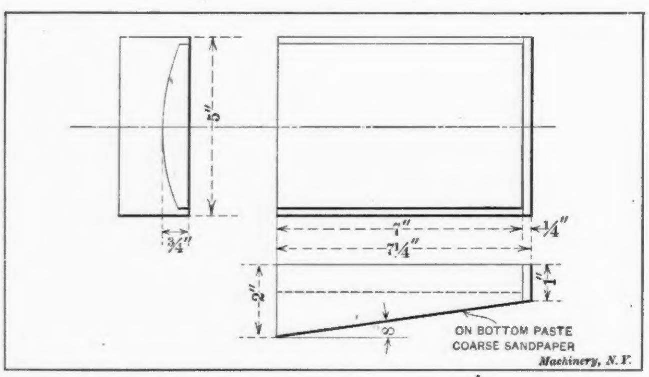
It is sometimes necessary to scribe holes in places where an ordinary scriber cannot be used, as through holes 1/16 inch diameter in a thick piece of metal. I overcame this difficulty by using a jewelers' pin-vise, with a darning needle held in it for a scriber. The darning needles used are about four

inches long and 0.040 inch in diameter. These needles cost five or six cents a dozen and they can easily be replaced when one is broken or dulled. I have shown this scriber to fellow tool-makers, and it is readily adopted wherever shown.

Passaic, N. J. L. ROSENTHAL.

DRAFTING TABLE PENCIL-HOLDER

The pencil holder shown in the illustration may be made of either wood, or aluminum. A very pretty effect is secured by making it of ½-inch strips of maple and cherry alternating. As an eight degree tilt is a convenient one for a table, this holder is made with the same angle so as to keep the



pencils from slipping out. By having sandpaper on the bottom, it can be used on a table that is considerably tilted by turning it around and having the cleat down. Most all draftsmen are subject to annoyances arising from having their pencils and pens scattered all over the table; this holder, as can readily be seen, will remedy that.

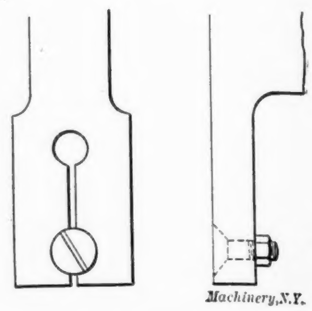
Three Rivers, Mich. E. G. PETERSON.

RESTORING OVER-EXPOSED BLUE-PRINTS

The average drafting office cannot keep a boy constantly making prints, and, consequently, when the boy is started tracing and intends to keep an eye on the printing frame, the print is often sadly neglected. Finding that in time this waste of paper was quite an expense item, we bought a quarter pound of potassium bi-chromate (a reddish crystal), dissolved it in a gallon of water, and placed the solution in a tray beside the wash tank. If a print is overexposed or "burned," it is first placed in this solution and then washed in clear water; in this way we seldom lose a print because of overexposure. It is, of course, possible to so burn a print that it cannot be bleached, but the ordinary burn of from two to ten times the required exposure, responds to the above treatment. The solution keeps indefinitely, if a few crystals and also water are occasionally added when required.

Rochester, N. Y. RALPH W. DAVIS.

ADJUSTABLE SLOT-FINISHING TOOL

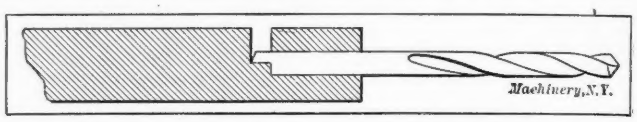


The accompanying engraving, which is self-explanatory, shows an adjustable slot-finishing tool for the planer. When much of this work is done, the dulling of the side edges will, in a few days, cause the tool to cut small, which, when the slots have to be exact, can be only remedied by forging. An adjustable finishing tool like this one will stay out of the blacksmith shop a dozen times as long as a solid tool.

Middletown, N. Y. DONALD A. HAMPSON.

AN EXTENSION DRILL

The accompanying illustration shows a way of making small extension drills, that may be new to some. In the extension rod a hole is first drilled which is a snug fit for the shank of the drill to be used. Then, after measuring the depth of this hole and marking it on the outside of the rod, a slot is filed at the farther side of the mark half way through the extension rod, so that it just meets the bottom of the hole. This slot should be approximately as wide as the diam-



eter of the drill. Next, the shank end of the drill is filed to the center for a distance equal to the width of the slot. After the drill is pressed into the extension rod as shown, it is ready for use. In this way an extension drill can be made much more quickly than by the old soldering method, and after using, it may be easily pulled apart without injury to the drill. CHESTER L. LUCAS.

East Saugus, Mass.

TO REMOVE BROKEN WOOD SCREWS AND NAILS

Perhaps nothing is more exasperating to the amateur wood worker than to have a wood screw break in hard wood just before it is screwed home, or to break off a nail where another nail must be driven. Such accidents are particularly provoking to a machinist. His experience on metal work is not of much assistance to him in overcoming such dilemmas, and to such the following kink is worth description. Secure a brass or steel tube slightly larger than the shank of the broken screw. File teeth in the end and give them the proper set, bending alternate teeth out and in. You thus are equipped with a hollow drill, which can be slightly squared at the other end to fit a carpenter's brace. With this tool the wood surrounding the broken screw can be trepanned out; the hole should then be filled with a plug of the same wood set in glue. After the glue has set a hole can be bored and a new screw can be put in, and no one will be the wiser.

M. E. CANEK.

* * *

The principal buildings, bridges, and other municipal structures of New York will be ablaze with lights during the Hudson-Fulton celebration. All bridges and principal buildings are outlined with rows of eight-candle power electric lights, and 1,500,000 lamps have been strung. The incandescent lights alone amount to 12,000,000 candle power, and will require about 42,000,000 watts or 56,000 horse-power. Beside the incandescent lamps there will be flaming arcs and other lamps of great power. The illumination will continue every night from September 25 to October 9 from 6:30 to 12:30.

NEW MACHINERY AND TOOLS

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP

BATH DUPLEX INTERNAL GRINDING MACHINE

An improvement on the duplex internal grinding machine brought out by the Bath Grinder Co., of Fitchburg, Mass., which was mentioned in a note in the April, 1909, issue of MACHINERY, has recently been placed on the market. This improvement embodies a number of new and interesting features which are illustrated in the accompanying half-tones, Figs. 1 to 4 and in the line engraving Fig. 5. This machine is distinctly a new departure in internal grinding machines, and places internal grinding on as practical a basis as that which external grinding has achieved during the last decade.

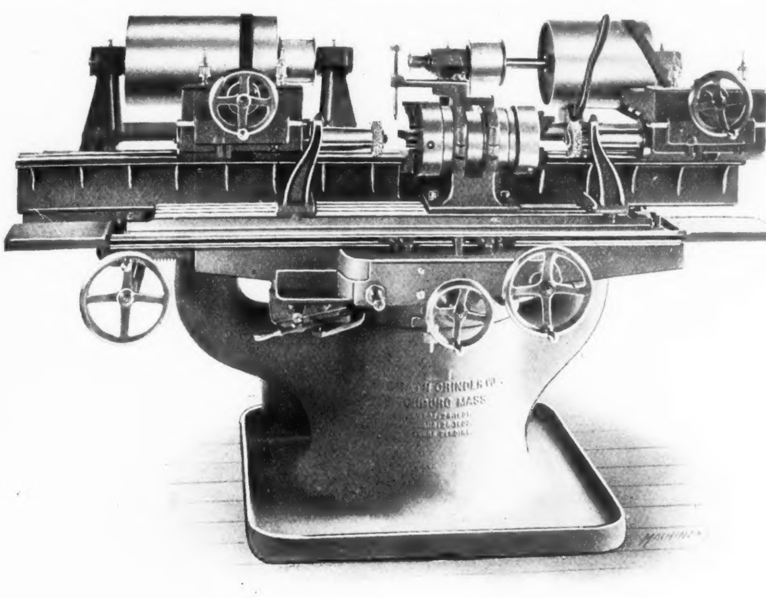


Fig. 1. Bath Duplex Internal Grinding Machine, having Two Wheel-spindle Heads

General Features

The principal advantage of the Bath duplex grinder is that the arrangement of the grinding spindles and the work-holding head or heads makes it possible to gain considerable time in the grinding and gaging of internal work; two pieces can be ground on the machines simultaneously, and it is not necessary to shift the reciprocating slide in order to gage, insert or remove the work. It is possible to use two grinding wheels at once, one operating from each end of the work. It is also possible to use a number of grinding wheels mounted on a supported spindle between the two grinding heads, and to quickly grind the inside of a sleeve or bushing by having one wheel after the other enter the work, the previous wheel, of course, leaving the work before the next one enters. This saves considerable time over the necessity of reversing the reciprocating table for each cut, as is necessary with grinding machines of the common type.

The novel feature which distinguishes this machine, in particular, from other designs, is that the grinding wheels and spindles pass in through the back end of the head-stock spindle as shown in Figs. 2 and 5, instead of running into the head-stock spindle from the front as in other grinders. Internal grinding has commonly been considered as a slow process when a large amount of stock has to be removed, but this objection is effectively overcome by the innovations in this design, and a considerable increase in production has thus been made possible.

Fig. 1 shows the machine set up for grinding bushings held in four-jaw chucks, one chuck being mounted on each end of the head-stock, and the grinding heads, wheels, and wheel spindles being shown one on each side of the head-stock. In Fig. 2 the machine is shown especially fitted up for automobile work, and is set up for grinding the bores of spur gears. In front of the machine on the floor, a variety of work that has been ground on this machine is illustrated. The spur gear standing on its face in front of the machine is one of the pieces being ground at the moment in the machine. In this case, two head-stocks are mounted on the table, the spindles of these head-stocks being 8 inches in diameter. The object of the large head-stock spindle is to make it possible to grind large work, up to 6 inches in diameter, by holding it inside of the chuck spindle, thereby absorbing and eliminating the vibration and the twisting stresses when the wheel is brought against the work.

In front of the machine to the left of the handwheels is shown the reverse lever. This lever, by being turned one-quarter of a revolution, automatically stops the machine at the end of its stroke, and also reverses the reciprocating slide. The operator does not need to wait to operate the lever until the slide reaches the end of the stroke, but can turn the knob at any time during the stroke at the end of which it is wanted to stop the machine automatically. When the machine is stopped, the end of the work in one of the head-stocks is exposed to view, and is in position to be gaged instantly. To gage the work held in the opposite head-stock, the reverse lever is pushed over, which brings the other head in position to gage. The general relation of work and spindles is plainly shown in Fig. 5. The distance between the two head-stocks is sufficient so that when one of the spindles is in the position shown with the wheel to the right just projecting

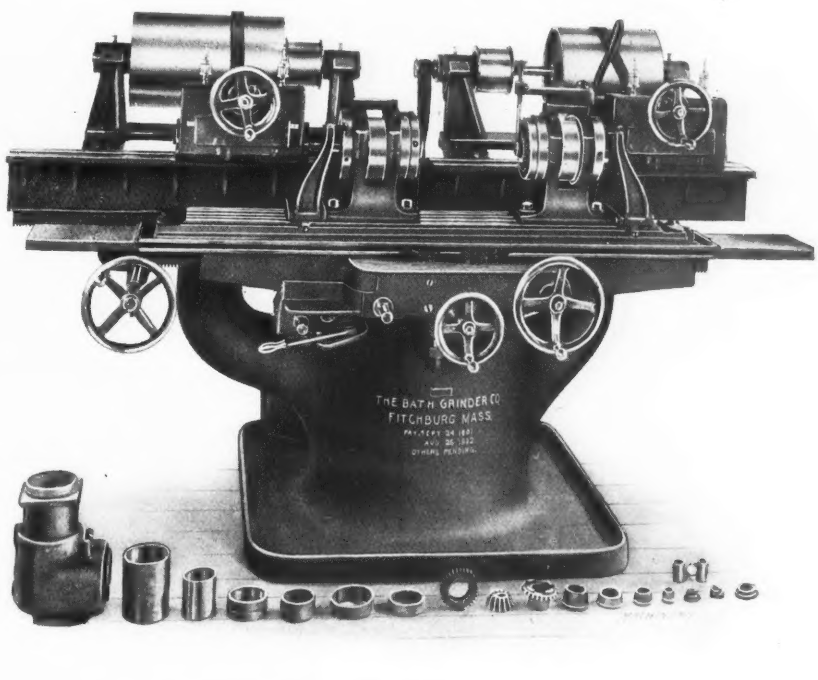


Fig. 2. Bath Internal Grinder Specially Equipped for Automobile Work

through the work and head-stock, the work in the other head-stock can be easily removed and a new piece of work mounted in position for operation. It will be also noticed that considerable time is saved by this construction when gaging the work, as it is not necessary to move the reciprocating slide away from the head-stock in order to measure the size, as is

required in internal grinding machines of general design; the time consumed in measuring two pieces of work is practically no more than that required for measuring one in a single-spindle machine.

Head-stock and Spindle Heads

The head-stock spindles are driven directly from a drum counter-shaft, the same as in ordinary grinding machines, the only difference being that one belt is, of course, required for each head-stock. The grinding-wheel spindles are driven by a belt from drums provided directly on the machine as shown, the shafts on which these drums are mounted being provided with small pulleys driven directly from the counter-shaft. Thus the complete machine is driven by a two-piece counter-shaft, one for furnishing the power for the wheel-spindles and one for the head-stocks, in a manner similar to that of the ordinary type of grinders.

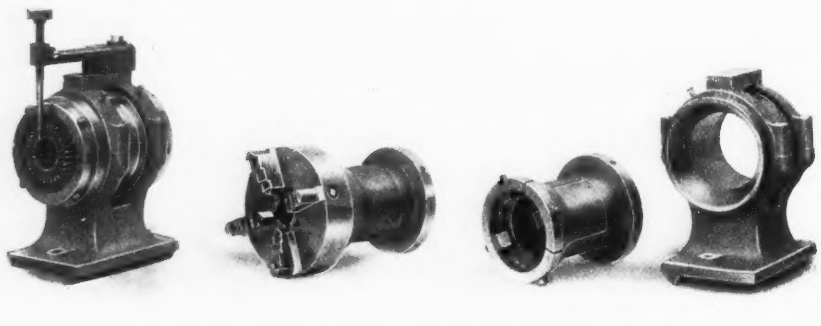


Fig. 3. Assembled and Dismounted Head-stock and Parts

Fig. 4. A Set of Grinding Spindle Extensions for the Duplex Grinder

Each of the grinding-spindle heads is provided with an automatic sizing feed so that the wheels can be fed up to the work independently of one another. The automatic feeds are operated by hinged arms which come in contact with the ends of square rods on the head-stock, thus causing the automatic feed to be operated the same as the power automatic feed on grinders in general. Each spindle-head has a sizing device so that each slide can be set to remove a predetermined amount of stock, and when the required size has been reached the automatic throw-out arrangement disengages the feed. An adjustment is also provided for the variation in the diameter of the wheels.

The spindle-heads are carried on two long narrow slides instead of as formerly on one wide slide. On account of this construction the wheel-head is much more rigidly mounted and the deflection commonly met, due to the pressure of the grinding wheel, is largely eliminated. The narrow slides on which the spindle-heads are carried are mounted on a beam so that the spindle-heads can be placed in position longitudinally instead of moving the head-stock or vice versa.

In Fig. 3 are shown the two head-stocks shown in Fig. 2 with one of the head-stocks disassembled to show the method of holding the spring chucks. The four-jawed chuck is mounted in the same manner. At the outer end of the spring chuck there are four hardened steel jaws, which are detachable and which can be changed according to the diameter or size of work; special chuck jaws may also be furnished for holding either bevel or spur gears on the pitch line. The jaws are ground on the machine so that they are absolutely true with the spindle. The head-stocks shown in the illustrations are for straight work only, but swivel head-stocks of the type shown in Fig. 5 are furnished if required, so that straight or taper work can be ground, the tapers being set at any angle required. As the heads are entirely independent of one another, a straight hole can be ground in one head while a taper hole is being ground in the other. A traveling diamond is mounted on the top of the head-stock for truing the wheel whenever necessary.

The reciprocating slide is run at a speed of from 2 to 12 feet per minute. It has five changes of speed and is operated by a gear box underneath the cross-slide on the left-hand side, as shown in Figs. 1 and 2, and is controlled by a single lever.

Grinding Spindles

In Fig. 4 is shown a set of seven grinding spindles. The set of two spindles at the right, shown mounted on the extension arbor, are the two spindles shown in use in Fig. 2. The other spindles complete a special set furnished for automobile work, having lengths and diameters to suit the work to be ground. The extension arbor is attached to the wheel-head by fillister-head screws. Into this extension is threaded the secondary extension provided with a hexagon head on its end. This extension contains the bearings for the spindle proper, which revolves inside and which is driven from the main spindle by means of a projecting key or tongue on the end, engaging

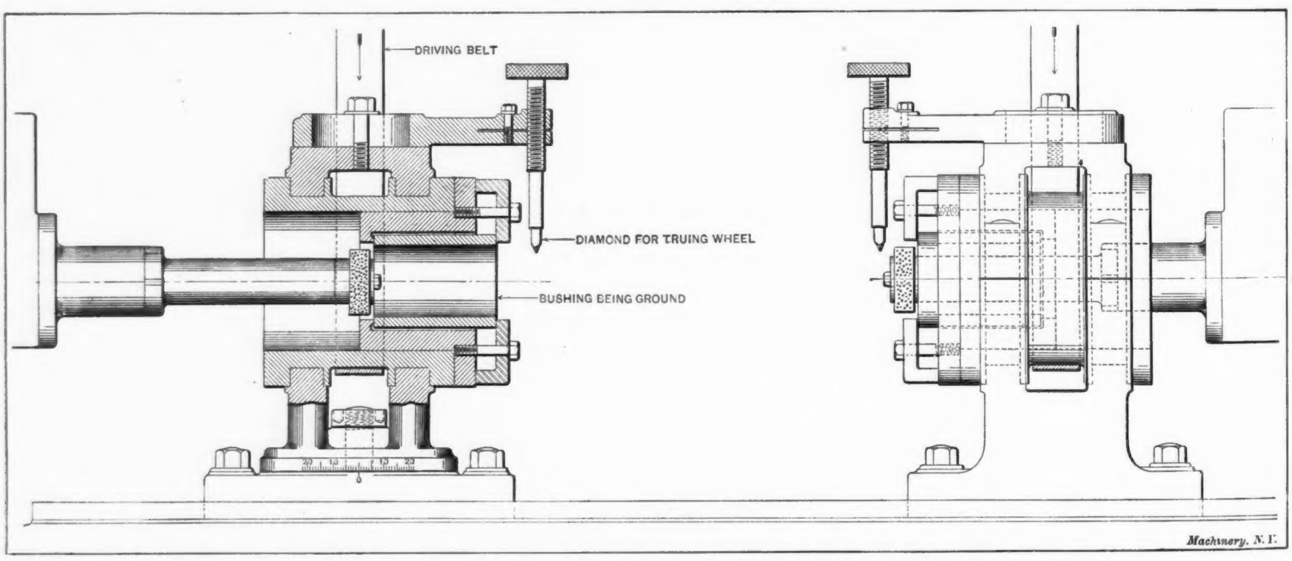


Fig. 5. Section and Elevation of Head-stocks and Work and Relation of Head-stocks to the Grinding Wheels

into a square slot in the end of the main spindle. The hexagon head on the secondary extension is a feature which was provided for special reasons. In changing these spindles, the operator of the machine many times loses the spanner wrenches, and to avoid inconvenience, a monkey-wrench can be used which at the same time assures that the spindle will be tightened up firmly.

The machine is also furnished with a supported spindle that can be mounted at each end in the spindle-heads and on which can be mounted from one to six grinding wheels. For example, in grinding a bushing 2 inches long, the wheels would be spaced apart the length of the bushing, and all six could pass through the bushing before being reversed. Another method that can be advantageously used is to hold the work to be ground in the spring collet and use the two single-ended grinding wheels brought up together and grinding at the same time, removing the stock within 0.001 or 0.002 inch of size. After this is done, one of the wheels can be stopped and the hole finish ground with a single wheel. Still another method advantageously used on this grinder is to employ a coarse wheel on the one head for roughing and a fine wheel on the other head for finishing the same piece of work. Parts like those for pneumatic hammers which have four bearings to be ground concentric with each other can be ground without reversing the work when once mounted, and the work can be gaged from either end of the chuck.

The amount of power consumed by the grinder is 2.7 H. P. By means of a brake provided, it is possible to stop the machine in four seconds with the belts at full speed. The machine in general has been rigidly designed so that it is possible to use larger and wider wheels and remove a larger amount of stock than with former designs.

Some examples of the capacity of the machine may be interesting. Some manganese car wheels having a bore of 3⅛-inch, 6 inches long, were ground in 55 minutes each, removing 5/32 inch of stock with a single spindle from a rough-cored hole. A 15/16-inch hole, 1¾ inch long, can be ground in two minutes with a single spindle removing from 0.006 to 0.008 inch of stock.

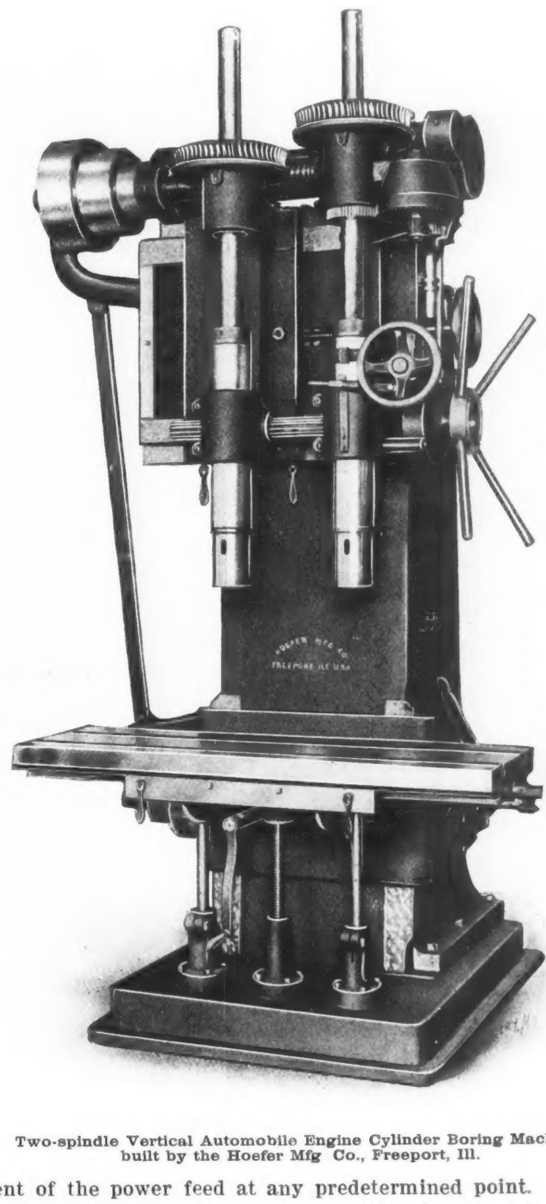
HOEFER VERTICAL TWO-SPINDLE CYLINDER BORING MACHINE

Considerable attention has been given by the Hoefer Manufacturing Co., Freeport, Ill., to the requirements of automobile manufacturers for a satisfactory cylinder boring machine. Such a machine must be able to finish the work both rapidly and accurately, and in order to accomplish these two objects the company has designed a very heavy two-spindle vertical automobile engine cylinder boring machine, an illustration of which is shown in the accompanying engraving.

The two heavy spindle heads are gibbed to a short stiff cross-rail. The right-hand spindle is solidly bolted to the rail and doweled with taper pins, while the left-hand spindle is adjustable by means of a screw operated by a hand-wheel, this adjustment providing for the variations in center distances in different sizes of engines. Tapered holes are provided in the adjustable head so that when jigs have been made for various sizes of engines, these holes can be drilled through into the cross-rail and pins inserted, thus providing positive stops for each size of engine cylinders, and a saving of time in locating the heads for each side.

The bearing of the spindle sleeve is slotted so as to provide for wear. The spindles themselves are made of high-grade crucible spindle steel, chosen with particular regard to its toughness, and are accurately ground so as to minimize the wear and insure the maintenance of accuracy, and are provided with No. 5 Morse taper sockets. The spindle sleeves are bushed with interchangeable phosphor bronze bearings, which can easily be replaced. The thrust bearings are also made of phosphor bronze. The spindles are driven through a pair of large double-threaded worms meshing with phosphor bronze worm-gears, the studs of which are ground and run in copper-hardened babbitt bearings. A substantial key in the driving worm-gear engages in a keyway in the spindle and insures that the drive is ample for any work within the range of the machine. The worms are encased in an oil pan provided with a felt oiler, thus securing sufficient lubrication. An oil pan is also placed under each worm-gear to return any oil to the worm oiling cases. The final drive is obtained through spur gearing and by means of a three-step cone pulley having wide steps for a belt of sufficient size.

A positive gear feed similar to that furnished with the company's regular line of drills is provided. This feed is driven directly from the main spindle, four changes are provided, and the entire gearing mechanism is encased in a feed gear box. The vertical worm is thrown into engagement with the phosphor bronze gear encased in the worm-wheel shell, by means of a small lever directly in front of the operator, and an adjustable automatic stop is provided for the disengagement of the power feed at any predetermined point. A long cross-spindle with teeth cut the entire length drives both spindles uniformly.



Two-spindle Vertical Automobile Engine Cylinder Boring Machine, built by the Hoefer Mfg Co., Freeport, Ill.

The table is made exceptionally deep vertically, to give it the necessary stiffness, and prevent springing when jigs are clamped to it. The bearings in the saddle are large, and proper provision is made for lubrication, the oil holes being in the front of the machine for convenience in oiling. The traverse of the table is obtained by means of a coarse lead-screw or by a rack and pinion, according to the requirements of customers. The table is gibbed to a rigid knee, which besides having ample vertical depth, is also provided with two supports in addition to the elevating screws. The bearings are wide both in the saddle and on the column, and stout ribs resist the twisting strains brought to bear upon the knee when the table is heavily loaded and at the end of the travel.

The method of operating the machine is very rapid and simple. Four units of two cylinders each can be placed in a properly designed jig, and cylinders Nos. 1 and 3, for instance,

are bored simultaneously. Then the table is moved over and cylinders Nos. 2 and 4 are bored. While the process of boring these cylinders takes place, cylinders 5, 6, 7 and 8 are placed in position in the jig. As soon as the work is completed on the first set of two units, the table is set over so that cylinders Nos. 5 and 7 can be bored, and then Nos. 6 and 8. Meanwhile new cylinders are placed in the jig on the opposite end of the table. Thus a practically continuous process of boring is made possible. The method, as described, insures great accuracy in the alignment of the bores.

The total height of the machine from the floor to the top of the column is 110 inches, and the maximum distance from spindle to table 39 inches. The maximum distance from center to center of the spindles is 19 inches, and the minimum 9½ inches, the distance from the column to the center of the spindle being 12½ inches. The vertical feed of the spindle is 19 inches, and the feeds per revolution of spindle are 0.062, 0.125, 0.187 and 0.250 inch. The size of the table is 18 x 56 inches, and the floor space 52 x 58 inches. The net weight of the machine is 8,000 pounds.

THE COIT TWENTIETH-CENTURY BALL-BEARING DRILL CHUCK

The drill chuck shown herewith is made by the Standard Machinery Co., Mystic, Conn. As may be surmised from a study of the parts, shown disassembled in Fig. 2, it is of the type in which the jaws are tightened on the drill by the resistance required to drive it. There is thus no possibility of its slipping, as the drive is proportioned to the work required of it.

The chuck consists, as may be seen, of a taper shank or mandrel (forming an integral part of the tool), a knurled shell or jaw holder free to revolve on the mandrel against a

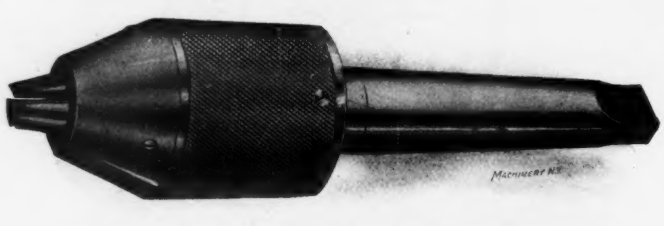


Fig. 1. Coit's Ball-bearing Drill Chuck, made by the Standard Machinery Co., Mystic, Conn.

ball thrust bearing, a collar provided with slots for the heads of the jaws, and the jaws themselves. The parts, it will be seen, are few, simple and of strong design. In operation, the turning of the knurled sleeve of the assembled chuck with its jaws, rotates also, on the threaded mandrel, the collar in which the heads of the jaws are contained. As the collar is thus screwed in or out on the mandrel, the jaws are screwed in or out of the chuck, and thus released or tightened on the work.

The use of a right-hand thread on the shank makes the chuck self-tightening for a right-hand drill. If the drill is barely caught in the jaws, the moment it strikes the work, resistance to turning is offered, and the rotation of the whole chuck sleeve and jaw is arrested. This screws the collar out on the mandrel, pushes the jaws forward, and thus tightens the grip. Any increase of resistance, accompanied by a corresponding slippage of the sleeve, is met by an immediate strengthening of the hold.

In spite of this positive drive, the operator can release the drill with a gentle twist on the knurled sleeve. This easy release is made possible by two things: first, the use of the ball thrust bearing; and second, the small diameter of the thread by which the adjustment is effected. This small diameter reduces the friction, and thus prevents jamming the chuck, no matter how strong the drive. It is, in fact, the practice of the workmen, in using this chuck, to insert and remove drills while the spindle is running, at all except the highest speeds.

Attention should be called to a number of points in the general design of the chuck. The end of the mandrel has a bearing in the sleeve, making a stiff unyielding journal for the turning of the one on the other. The jaws seal the only possible entrance for grit and chips into the interior, which is thus protected from injury and wear. One application of oil will last almost indefinitely. The mandrel is a part of the chuck, and is sold as such, so the expense of making it is saved. It will be furnished with any suitable taper, or with a straight shank. The separate jaws can be removed or inserted without taking the chuck apart.

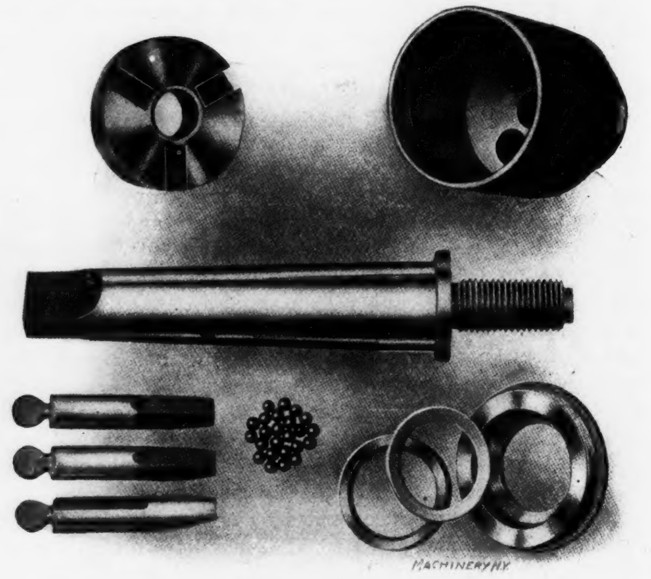


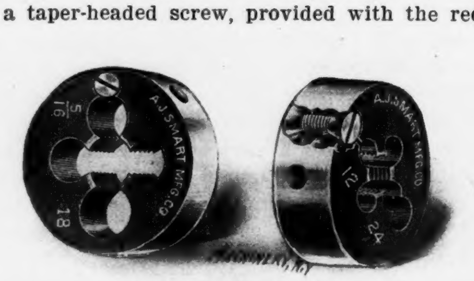
Fig. 2. Chuck Disassembled, showing Parts and Simplicity of Construction

Perhaps the most valuable feature of a tool of this kind is the saving of the drills. Since there is no slip, the shanks are protected from marring and stripping, and their useful life is greatly lengthened. It is possible to drill to a reasonable depth also with an old, short drill, as a very short drive in the chuck jaws does as well as a longer one.

These tools are made with great care, to judge from what can be seen on a visit to the factory. Special pains are taken to make them accurate and interchangeable. Five sizes comprise the complete line, ranging as follows: No. 1, 0 to 13/64 inch; No. 2, 0 to 21/64 inch; No. 3, 0 to 17/32 inch; No. 4, 1/16 to 3/4 inch; and No. 5, 5/16 to 1 inch.

SMART ROUND ADJUSTABLE DIE

The accompanying engraving shows the design of a line of improved round adjustable dies made by the A. J. Smart Mfg. Co., Greenfield, Mass. The dies are sawed through on one side as usual, while the opposite side is drilled out and spring tempered, leaving but a small portion of the metal. As seen from the illustration, the adjustment of this die consists of a taper-headed screw, provided with the required de-



Round Adjustable Die of Improved Design, made by the A. J. Smart Mfg. Co., Greenfield, Mass.

gree of taper to insure a quick and positive adjustment. This screw enters into a cone-shaped nut of the same taper as the head of the screw. When the screw is turned to the left, the head will rise relatively to the nut and the spring temper causes the die to close, thus making it cut a smaller size. By turning the adjusting screw to the right, the screw enters further into the nut, and on account of its taper head, it spreads the die open so that it will cut a larger size. One of the principal advantages of this die is that it can be adjusted from the face without being removed from the holder in which it is used. These dies are made with 13/16, 1, 1 15/32, 1 1/2 and 2-inch outside diameters.

NEWTON TWO-SPINDLE LOCOMOTIVE FRAME DRILLING MACHINE

The accompanying half-tones, Figs. 1 and 2, illustrate a new design of two-spindle drilling machine recently brought out by the Newton Machine Tool Works, Inc., Philadelphia, Pa. This machine has been designed with the object in view of giving it sufficient range and flexibility of operation for work on parts for all sizes and types of locomotives, and is, in addition, particularly adapted for drilling the holes in locomotive frames.

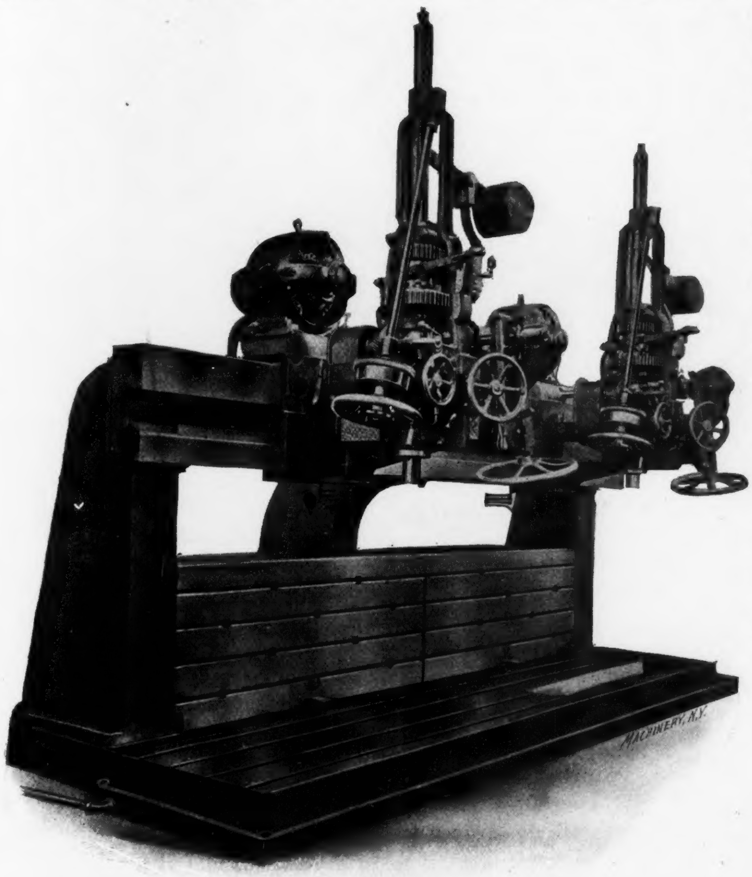


Fig. 1. Front View of Newton Two-spindle Locomotive Frame Drilling Machine

The spindles of the two drilling heads are 4 inches in diameter, and have an automatic geared feed of 18 inches, and a vertical adjustment of the same amount through direct connected gearing for the fast hand traverse, and through a worm and worm-wheel operated through a friction clutch for the slow hand adjustment. The range of the spindle speeds is from 28 to 456 revolutions per minute, and four changes of feed are obtainable, being, respectively, 0.0078, 0.0126, 0.0156, and 0.0225 inch per revolution of spindle. The spindle sleeves have a length over-all of 48 inches. The lower part of the sleeve bearing is in the head or saddle proper for a length of approximately 28 inches; this eliminates all unnecessary overhang. The spindle sleeve revolves in brass bushed bearings of ample dimensions, and the top of the sleeve is supported in brass bushed bearings in the rack sleeve yoke.

A departure from the common design of the driving mechanism lies in the fact that the spindle sleeve carries the clutch gears by which it is driven, and also the clutch for their engagement. The spindle is counter-weighted and is provided with a roller thrust bearing at the bottom of the rack sleeve. It is provided with a taper hole to take No. 5 Morse taper shank. Fast reversing traverse is provided for the saddle on the cross-rail by means of a double train of bevel gears and a clutch. A horizontal adjustment of the saddle is obtained by hand by means of the hand-wheels shown at the bottom of the arms in Fig. 1. The minimum distance between the centers of the two spindles is 4 feet, and the maximum distance 15 feet.

The spindles are driven by individual 10 horse-power electric variable speed motors, the speed variation being from 300 to 1,200 revolutions per minute. The motion is transmitted from the motor shaft to the horizontal driving shaft by spur gears. On the driving shaft is mounted a double train of bevel gears, and from here the power is transmitted to the vertical shaft on which the spur back-gears are mounted, giving two changes of speed in addition to the range of speed changes of the motor. The bracket on which the motor is mounted is cast solid with the arm, this giving a very rigid construction, which is, in particular, required when subjecting the machine to the heavy strains occurring when using high-speed steel drills.

As will be seen in Fig. 1, the gears controlling the feed mechanism are mounted in a gear box, the different combinations being engaged by a key controlled by a small hand lever, as shown. Lateral hand adjustment is provided for the spindle saddle on the arm, the range being from a minimum distance of 6 inches to a maximum distance of 24 inches from the face of the cross-rail to the center of the spindle. The arm has two bearings on the top of the cross-rail, these being removable for renewals and provided with brass taper shoes to compensate for wear. The cross-rail is of the box type construction and is of very heavy ribbed section.

The machine is furnished with two adjustable tables for holding the work, each being 30 inches wide by 36 inches high by 7 feet 6 inches long. These tables are of box type construction, having vertical and horizontal working surfaces provided with large T-slots for clamping the work. The machine is also provided with a floor plate, the front part of which is provided with T-slots and which provides for a work table 39 inches wide by 17½ feet long. This work table is entirely surrounded by an oil pan for receiving the lubricant. The bed plate also supports the three heavy uprights which hold the cross-rail. The upright in the center is of special construction in order to permit the two adjustable work tables to be adjusted or moved entirely out of the way, when the lower table is used, as shown in Fig. 1. In Fig. 2 are

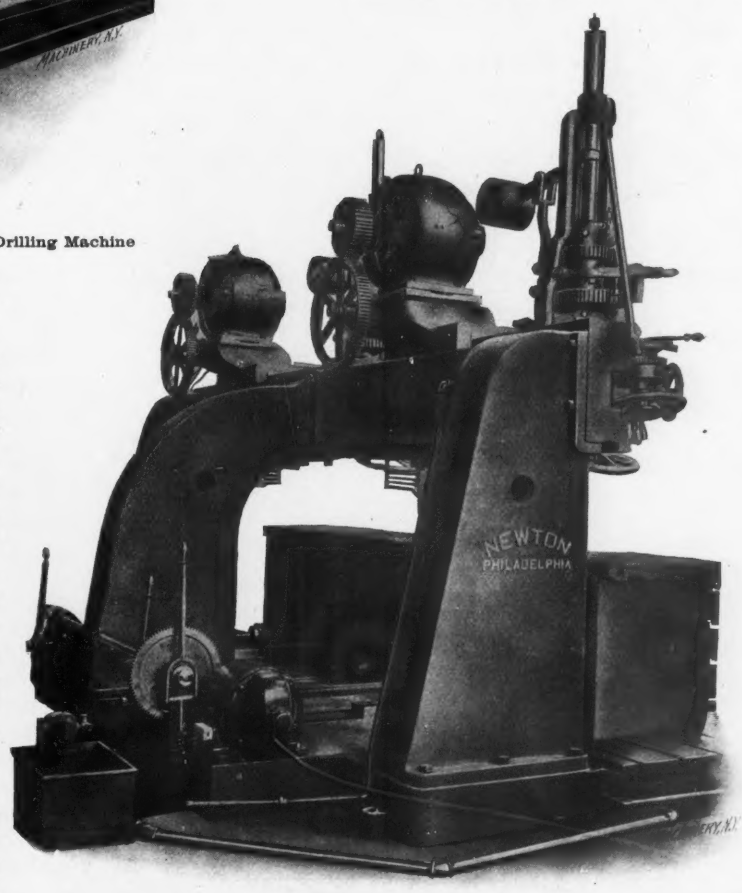


Fig. 2. Rear View of Newton Two-spindle Drilling Machine, showing Motor which operates the Adjustable Work Tables

shown the coarse-pitch screws provided for adjusting the work tables. The motion for this is transmitted through individual worms and worm-wheels from a five horse-power General Electric motor. This design permits of either simultaneous or independent power adjustment of the work tables. A pump, piping, and oil tank are also provided with the machine, as shown in Fig. 2. All bearings on the machine are bronzed bushed, and all gears are made either of steel or bronze.

The drilling mechanism is of the same general design as that provided for the radial drilling machines made by the Newton Machine Tool Works, with which it is possible to drill three-inch diameter holes at the rate of three inches per minute when using a flat twisted drill. Smaller diameter drills can be driven at a much higher rate of speed, in proportion. The maximum distance from the floor plate to the end of the spindle is 81 inches and the minimum distance 64 inches. The machine occupies a floor space of about 19 by 20 feet.

NOS. 3 AND 3A CINCINNATI AUTOMATIC GEAR-CUTTING MACHINES

In the May, 1908, issue of MACHINERY, we described an automatic gear-cutting machine built by the Cincinnati Shaper Co., Cincinnati, O. The making of this machine has since been transferred to the Cincinnati Gear-Cutting Machine Co., of the same city, which has brought out the smaller-sized

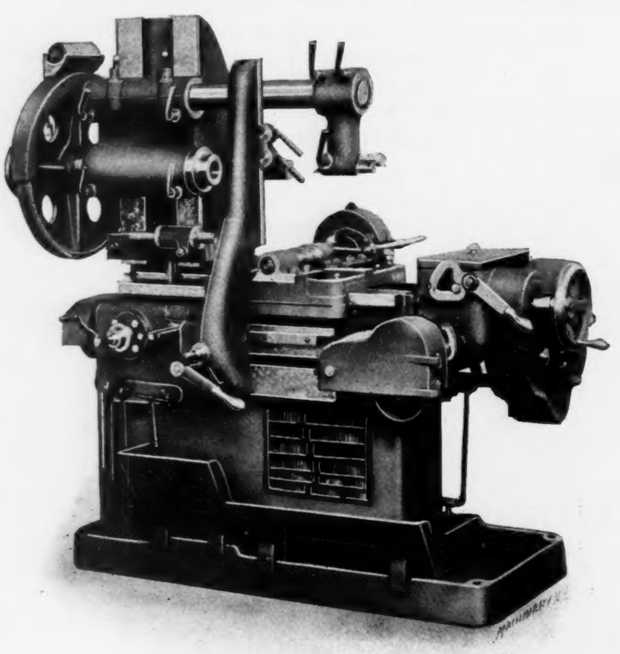


Fig. 1. A New Cincinnati Gear-cutting Machine, of a size well adapted to Automobile Work

tool illustrated herewith. This is made in two heights of column, giving maximum diameters of 26 inches and 36 inches respectively, for gears having any width of face up to 10 inches. It will be seen to be particularly adapted in its dimensions to automobile work, as well as to the general run of small and medium machine work.

The main features of the original design are retained. The machines are noticeable for their strength and simplicity. In the matter of rigidity attention is called to the carrying of the ways for the cutter slide beyond the column, and to the locating of the spindle bearing in the middle of the cutter slide. Fig. 3 shows the cutter slide turned bottom up, and gives a good idea of the construction of the full length taper gibs used. The principle of broad bearing surfaces with grinding surfaces located near together, is employed. The same principle applied to the work saddle prevents it from dropping out of parallelism when the clamps are loosened, to adjust the work to the required depth of cut. This adjustment is effected from the front of the machine, and is provided with a graduated index reading to one-thousandth of an inch.

The dogs for controlling the movement of the feed-slide are adjusted from the front of the machine, being mounted on threaded rods at the rear, connected by bevel gearing with crank-shafts at the front. A retractable tappet for these dogs is provided, so that the slides can be run to the extreme back position, for removing blanks without disturbing the setting of the dogs. There are twelve changes of feed. The cutter slide is fed forward and retracted by a screw, controlled by

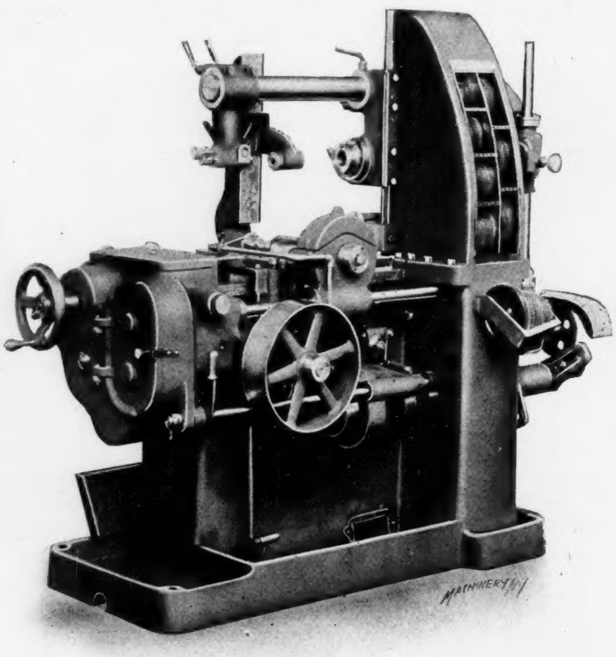


Fig. 2. Rear View of No. 3 Machine, showing Driving Connections

a reversing mechanism which gives a constant return speed, regardless of the feed. Twelve changes of feed are provided.

The cutter spindle shown mounted in its bearing in Fig. 5 is of large diameter, accurately ground and easily accessible for taking up wear. It is mounted in both taper and straight bronze bearings, and is adjustable endwise for centering the

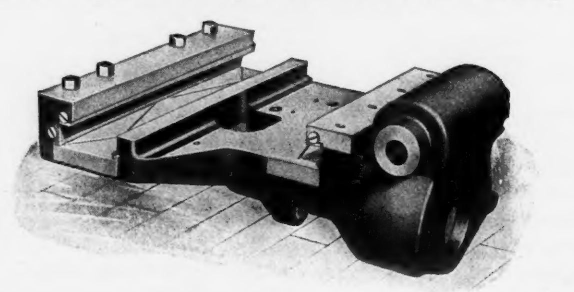


Fig. 3. Cutter Slide Reversed, to show Gibs and Bearing Surfaces

cutter. The drive, as shown, is through a worm and wheel, with means provided for taking up the end thrust of the worm. A removable outboard bearing for the cutter arbor is provided, the latter being drawn into place in the spindle or forced out by a threaded bolt. Six cutter speeds are provided.

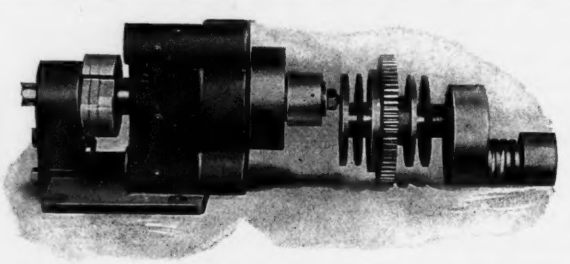


Fig. 4. Friction Stop Mechanism for Indexing; shown Assembled and Dismantled

The indexing mechanism is of unusually simple construction, there being fewer gears in the index train than on any other machine of this type. The motion is transmitted and controlled through a friction operated stop disk, simple and easily accessible. This mechanism is shown in Fig. 4. A spanner wrench is the only tool necessary for adjustment. The index worm can be disengaged from the wheel quickly,

and brought back into the exact meshing depth; or it can be disengaged from the index gears and rotated any desired amount for resetting work, after which it may be again secured. Besides provision for automatic indexing, it may be made to space once or revolve continuously, by a hand movement under the control of the operator. The mechanism is so interlocked with the cutter slide feed that the various movements must of necessity take place in proper sequence, thus making it impossible to spoil work from failure of the mechanism. The change gears furnished cut all teeth from 12 to 100, and all numbers from 100 to 450, with the exception of prime numbers and their multiples.

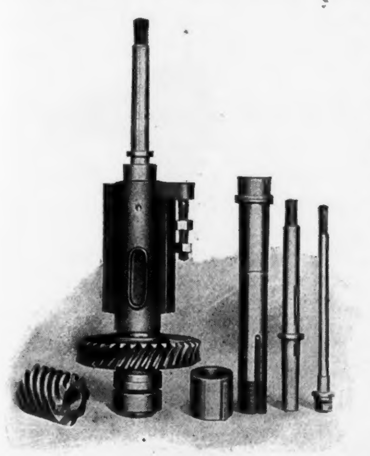
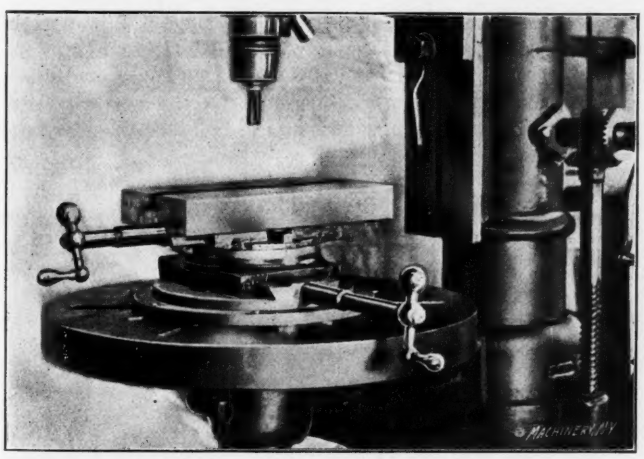


Fig. 5. The Cutter Spindle, its Worm-gear Drive and Axial Adjustment

As may be seen, the work arbor is provided with an over-arm work support, in addition to the regular outboard support. The machine is regularly equipped with a counter-shaft, though if desired it will be furnished with tight and loose pulleys mounted on the initial driving shaft. It can also be arranged for motor drive if desired. This is a very simple matter as all the changes of feed and speed are effected by convenient transposing gears.

DAVIS MILLING ATTACHMENT AND COMPOUND TABLE FOR THE DRILL PRESS

The accompanying illustration shows a useful attachment manufactured by the Hinckley Machine Works, Hinckley, Ill., and known as the Davis milling attachment and compound table for the drill press. This device has been designed with a view to furnishing an attachment for the drill press table which enables milling work, particularly end milling, to be done in the drill press advantageously, when the regular milling machines in the shop are tied up with other work, or for use in cases where a regular milling machine is not available.



Milling Attachment and Compound Table for the Drill Press, made by the Hinckley Machine Works, Hinckley, Ill.

The device is simple in its construction and consists of a circular base which is clamped down onto the drill press table. This base is provided with a dove-tail cross-slide for the saddle, which, in turn, carries a swivel slide, the top of which is provided with a dove-tail into which fits the slide of the table proper. Both the saddle and the table are provided with hand feed adjusting screws having ball-crank handles. The swivel slide is graduated in degrees and can be set to any angle. The table is provided with a ½-inch T-slot longitudinally, as shown in the engraving.

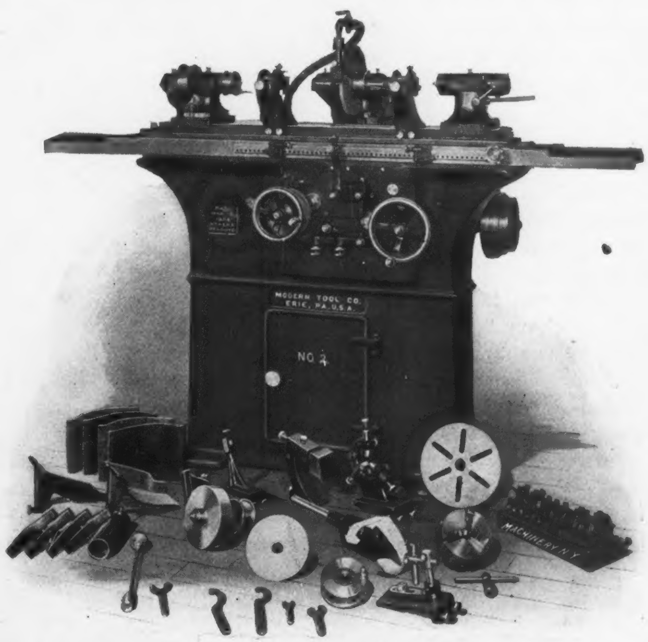
This device should prove a handy attachment for both large and small shops, and in repair shops where a regular milling machine is not available, in automobile garages, etc., it will prove of especial advantage on account of the simple and inexpensive substitute it provides for a regular milling machine.

MODERN UNIVERSAL GRINDER

The accompanying half-tone shows a universal grinding machine built by the Modern Tool Co., Erie, Pa., and designed with a view of placing on the market a heavy and rigid grinder with ample metal for absorbing the vibrations and preventing the ways from springing out of line.

The head- and foot-stock of this grinder are gibbed to the sides of the swivel table, this construction permitting of very large wearing surfaces, and making it possible to compensate for any wear which might occur on the head- or foot-stock. The head-stock is designed to swivel and is provided with a graduated base. The head-stock spindle is hardened, ground and lapped, and runs in phosphor-bronze bearings with means for taking up the wear. The end of the spindle is threaded and has a standard taper hole. Universal rests of new design, of great advantage when grinding long slender work, are furnished with the machine.

The driving and reversing mechanism is completely contained in and supported by a bracket bolted to the outside of the machine thus being easily accessible for oiling. If it becomes necessary to take off the bracket, it can be removed by unscrewing four bolts, and the entire mechanism can then be taken to a bench for cleaning or repairs. The wheel spindle is made of tool steel, is hardened, ground and lapped, and runs in phosphor-bronze bearings provided with means for taking up the wear the same as the head-stock spindle.



No. 2 Universal Grinder, built by the Modern Tool Co., Erie, Pa.

The table travels automatically, as usual, and is reversed in the common manner, by dogs. The power to the table is transmitted by worm gearing imparting a steady movement, free from jars. The reverse lever is so arranged that the table can be run past the point of reverse without disturbing the adjustment of the table dogs. An automatic cross feed is provided which gives a range of feed from 0.00025 to 0.004 of an inch. The feed can be thrown out automatically when the work has been ground to size. A simple attachment is also provided for fine hand feeds. There is no removable front plate, and the machine is so designed that the mechanism inside the grinder can be removed and replaced if required, without disturbing the alignment of the ways. A diamond tool holder is furnished for truing the wheel.

The machine is made in two sizes, Nos. 2 and 3, respectively. The No. 2 machine swings 9 inches in diameter and takes 26 inches between centers. The table is graduated up to 3½ degrees and 1½ inch taper per foot. This machine takes emery wheels up to 9 inches in diameter and ⅝ inch face. The

weight of the machine is 2,300 pounds, and the floor space required 36 x 94 inches. The No. 3 machine swings 13 inches in diameter and takes 32 inches between centers. The table is graduated up to 5 degrees and 2-inch taper per foot. This machine will take emery wheels 12 inches in diameter, ¾-inch face, and 9 inches in diameter, ½-inch face. The weight of the machine is 4,000 pounds and the floor space required 50 × 125 inches.

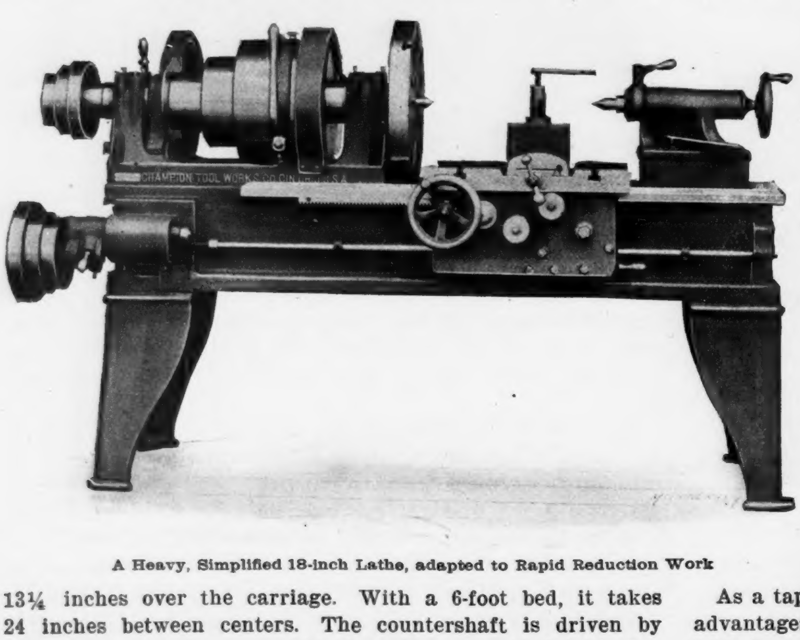
CHAMPION 18-INCH FRICTION BACK-GEARED MANUFACTURING LATHE

The heavy 18-inch lathe shown herewith was built by the Champion Tool Works Co., 2422 Spring Grove Ave., Cincinnati, O., to meet the requirements of the large automobile manufacturers. As may be seen, both drive and feed are belt operated, and the mechanism has been reduced to few but strong parts. No lead-screw for threading is needed or provided. The design has been found particularly successful in heavy manufacturing, requiring rapid reductions.

The spindle is driven by a three-step cone, whose large diameter is 14 inches for a 4-inch belt. The back gears are friction operated, the clutches being of the expansion ring type, operated by a toggle mechanism controlled by the lever shown at the front of the head-stock. This provision allows heavy roughing cuts to be taken at a slow speed, while a reversal of the lever gives the change to high speed for the finishing cut, without stopping the machine. The back gear ratio is 12 to 1. A 1⅝-inch hole is provided through the spindle.

The feed cones carry a 1½-inch belt. The lower cone is journalled in a swinging frame for tightening the belt, being clamped in position by a screw shown on the under side. An automatic throw-out clutch is provided on the feed rod inside the gear box. It is operative when feeding in either direction, and is controlled by the collars shown on the feed rod, which may be set at any desired point in its length. The feed can be reversed by the handle shown in the lower right-hand corner of the apron.

The lathe is equipped with a heavy plain tool block having power cross-feed. The tool used has a section of ⅝ inch by 1¼ inch. The machine swings 19⅛ inches over the bed, and 13¼ inches over the carriage. With a 6-foot bed, it takes 24 inches between centers. The countershaft is driven by 5-inch belts running over 12-inch pulleys, provided with full 12-inch diameter rim frictions. The net weight of the machine with the 6-foot bed is 2,500 pounds.

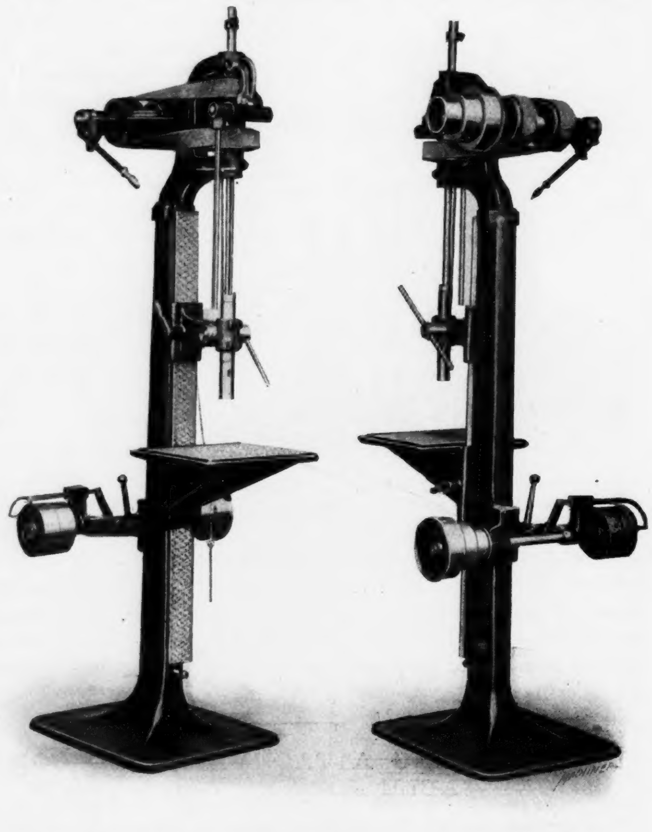


A Heavy, Simplified 18-inch Lathe, adapted to Rapid Reduction Work

KERN 15-INCH DRILLING AND TAPPING MACHINE

The attractive looking tool shown herewith is a new product of the Kern Machine Tool Co., 4657-4659 Spring Grove Ave., Cincinnati, O. It is especially designed to handle light drilling and tapping in an expeditious manner, being so proportioned and contrived as to combine strength, ease of manipulation and accuracy.

As a drill press, it combines the features expected in a machine of the sensitive type. By a very ingenious provision six spindle speeds are obtained with very little complication.



An Ingenious and Effective Combination of Sensitive Drill and Tapping Machine

The provision for doing this makes use of the tapping attachment, as will be understood from a study of the engravings. The counter-shaft mounted on the rear of the machine carries a three-step cone pulley belted to a mating pulley on the jack-shaft at the top of the machine. A double quarter-turn belt connects this with a large and small pulley, either of which may be engaged with the drill spindle by the operation of a friction clutch controlled by the vertical lever shown hanging down at the front of the machine. Owing to the difference of diameter of these two pulleys, it is evident that the three speeds obtained by the cones can be doubled, giving six, by connecting either the slow forward or fast reverse pulley with the spindle. The fast reverse speeds, however, would run the drills backward. To obviate this difficulty, a positive clutch is provided on the jack-shaft, by which it may be connected to either one of the quarter turn pulleys, making either of them the driver, while the other revolves idly. By this means the spindle may be reversed independently of the regular tapping attachment handle, so as to make the three fast reverse speeds available for drilling.

As a tapping machine, the tool would seem to have unusual advantages. The spindle pulleys are driven by a continuous belt, insuring a steady drive. The frictions are self-adjusting, allowing any tension to be put on that the operator may desire. The driving of the spindle by friction clutches minimizes the danger of breaking taps, since they may be so set as to permit the friction to slip, well within the breaking strength of the tap. The arrangement also permits a rapid starting, stopping and reversal of the spindle without shock or jar, whether in drilling or tapping work. An adjustable screw for the specially made endless belt is provided to increase or lessen its tension as required.

The drill has a total height of 79 inches, or of 99 inches

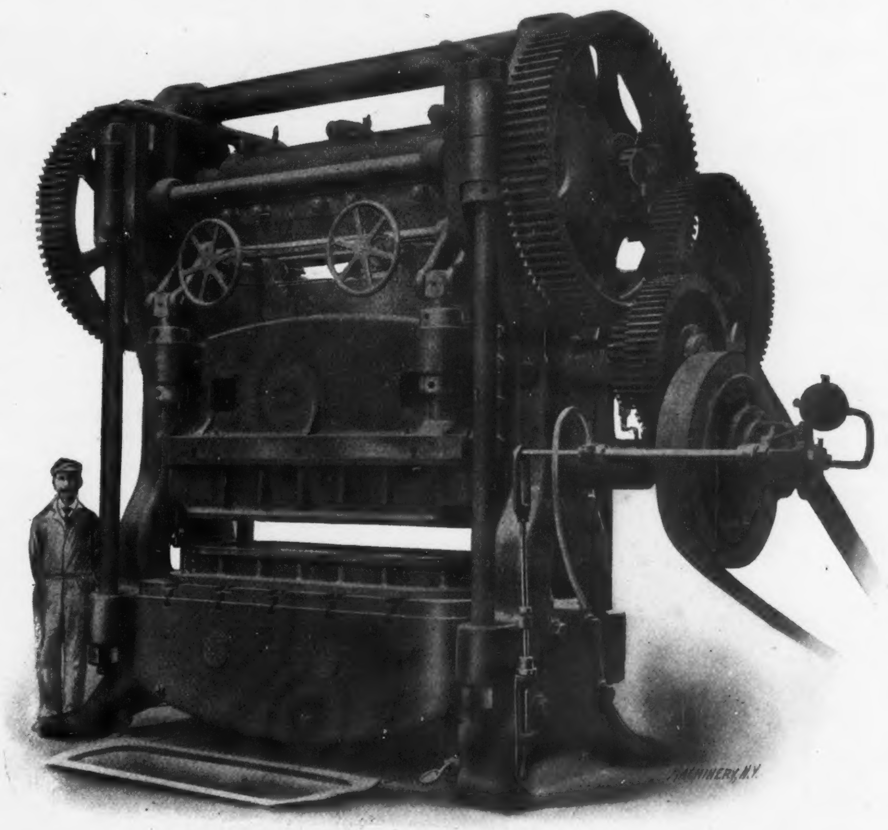
with the spindle extended. The spindle, which is counterbalanced, has a movement of 5½ inches. A driving socket for No. 2 Morse taper is provided. The table is 12½ by 14 inches, and is of the square type with a surrounding oil groove. The machine is also provided with a cup center and V-block. Both table and head are vertically adjustable on the column of the machine. The machine drills to the center of a 15-inch circle. Its net weight is 425 pounds.

FERRACUTE DOUBLE-CRANK TOGGLE-JOINT DRAWING PRESS

Presses for drawing seamless sheet metal shells are commonly designed with an outer ram or blank-holder, and an inner ram or plunger, thus making a double-acting press, as distinguished from the single-acting press which has but one ram. The outer ram may be held in position after having been moved down by various mechanical devices. The method most commonly used is to employ cams on the main shaft, and for certain shapes and sizes heavy springs are employed. A better and more modern device, however, is the use of a toggle- or knee-joint, which enables the pressure between the blank-holding surfaces of the dies to be taken more directly by the frame. This obviates the loss of power resulting from friction when the pressure is sustained by the crank-shaft. The press shown in the accompanying illustration is built on the toggle-joint principle, and has recently been placed on the market by the Ferracute Machine Co. of Bridgeton, N. J. It was designed by Mr. Oberlin Smith, president and mechanical engineer of the company.

The frame of the press is massive. The trussed bed, rests on shelves in the columns, to which it is securely bolted; each column is reinforced with two 4½-inch steel rods as shown in the illustration.

The ram and plunger have each an adjustment of 6 inches. The ram is adjusted by means of the round nuts shown in the engraving, and the plunger by means of the hand-wheels. The crank-shaft is forged from high carbon steel, and is 10 inches in diameter. It is reinforced by the long pitman-strap which unites the shaft and the plunger, the connection being made by two pitman stems. The latter are threaded and made to revolve simultaneously when adjusted by means of a shaft provided with two bevel gears. A link-belt joins the hand wheels, so that both revolve in the same direction when one is turned.



Double-crank Toggle-joint Drawing Press of Large Dimensions, built by the Ferracute Machine Co.

Two yokes, one on each side of the press, are attached to the plunger. These yokes have a vertical motion of 15 inches, the same as the stroke of the plunger. On the extensions of the middle toggle pins, rollers are provided, guided in slots in the yokes, the toggles being thereby straightened out at each stroke. The upper ends of the toggles are attached to the columns, and the lower ends to the outer ram.

The stroke of the outer ram is 6 inches, the plunger, as already mentioned, having a 15-inch stroke. The distance between the two columns is 100 inches, and the depth of the bed from front to back is 48 inches. The size of the hole in the bed is 60 inches by 18 inches. The distance from the bed to the outer ram at the top of the stroke, and in its extreme adjustment, is 32 inches, and to the inner ram or plunger, 35 inches.

The press is provided with triple gearing, the total ratio of which is 75 to 1; all gears are machine cut. The backshaft is of unusually large diameter, and the large gears mounted on the main shaft are of the same size at each end, which relieves the shaft from torsional stresses. These gears are 5 feet in diameter and have a face 10 inches wide. The fly-wheel is 40 inches in diameter and has a face 7 inches wide, and runs at an average speed of 500 revolutions per minute. This gives a speed of from 6 to 7 strokes per minute to the press. A friction clutch is provided by means of which the ram may be stopped at any given point of its stroke. In the illustration the press is shown equipped with a positive knock-out.

The weight of the press is 94,000 pounds, the height being 13 feet, the width 16 feet and the length or depth 7 feet. The pressure exerted is 500 tons. It is designated by the makers as "Press SA175."

LE BLOND HEAVY-DUTY LATHE EQUIPPED FOR CRANK-SHAFT WORK

The heavy-duty lathe built by the R. K. Le Blond Machine Tool Co., of 4609 Eastern Ave., Cincinnati, O., described in the New Tools department of the September, 1909, issue of MACHINERY, was intended to produce a high output in a wide range of machine work. A modification of this design has been developed by the builders to meet the requirements of manufacturers who have large quantities of duplicate lathe work, but are unwilling or unable to invest their capital in attachments which, for them, would be useless.

The changes made in this simplified design (known as the "heavy-duty automobile lathe") relate, as may be seen from Fig. 1, principally to the spindle drive and feed mechanisms. The head-stock remains the same as on the machine previously referred to, with the exception of the back gearing. Two back gear ratios are provided as before, but the change from one to the other is made with a sliding key operated by the hand lever directly in front of the driving cone. This replaces the double friction clutch arrangement used and found necessary for quick changes on a general purpose tool.

The quick change gear box is replaced by one giving four rates of feed. The changes are obtained by sliding gears operated by the crank handle shown at the front of the box. The four changes are doubled by a reversible compound gear arrangement on the end of the bed, thus giving the operator a choice of eight geared feeds covering a wide range. As before, the apron is double walled and built of a single box section casting. The lead screw and split nut are removed, however, along with the quick change gear device.

The lathe is shown equipped with a set of tools of a type which has recently come into favor for automobile crankshaft work. The tools are best seen in Figs. 2 and 3, where a crank (in the rough, except for the two end journals) is having its four crank pins squared and turned. The device consists, as may be seen, of a special chuck, a tail-stock fixture, a double tool carriage and an automatic stop mechanism on the apron.

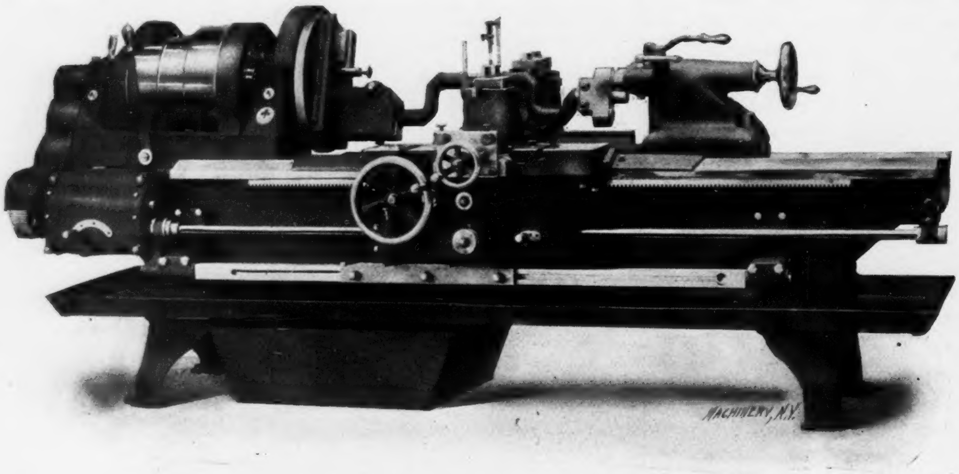


Fig. 1. Le Blond Heavy-duty Lathe arranged for Crank-shaft Work

The crank-shaft is held in a split bearing in the chuck by one of the turned end journals, and is driven by the V-shaped jaw which is screwed down on the first crank arm. This jaw pivots at its back end, and is fitted with a spiral spring under the clamping screw to facilitate chucking. This work holding fixture is carried on a scraped slide on the face-plate, to which it is attached by a clamp and an adjustable gib. It is accurately positioned for the two crank centers by a hardened steel locking pin entering hardened steel bushings in the face-plate, after which it may be securely locked in position by the two T-bolts. A counter-weight is provided on the back of the face-plate which is fitted with stops for its two positions, thus enabling the operator to counterbalance the crank in either position practically simultaneously.

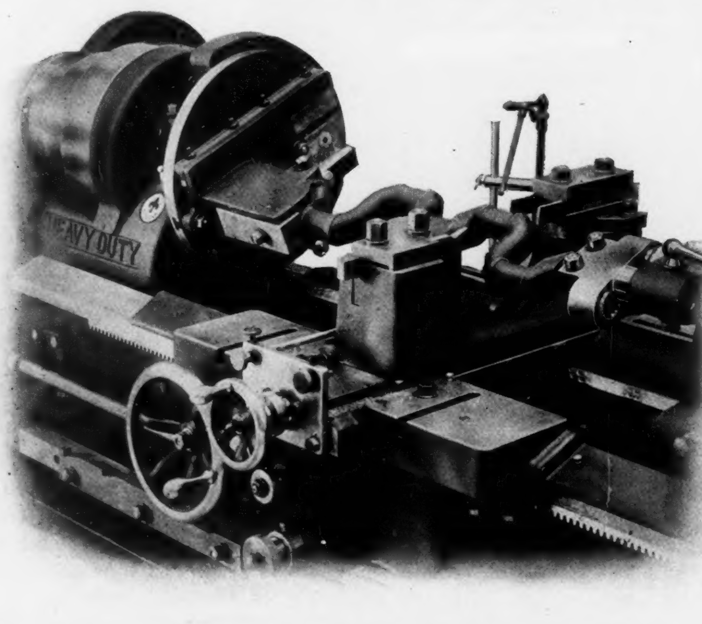


Fig. 2. Detail View, showing Special Holding Device and Tool Stops

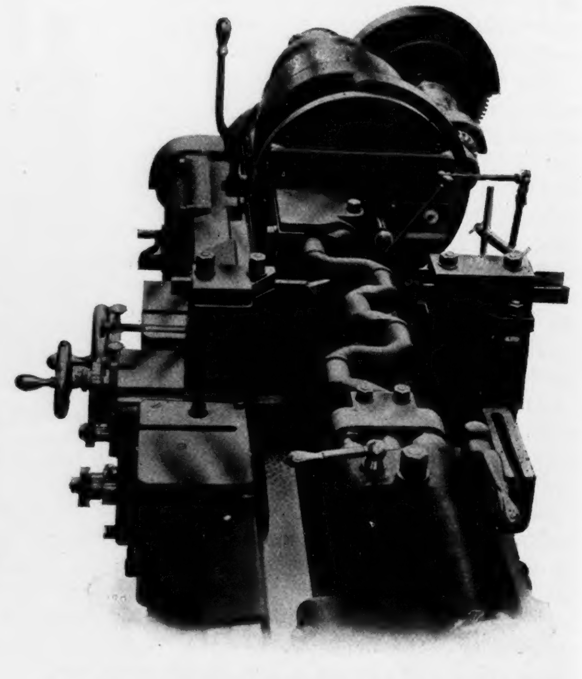


Fig. 3. The Arrangement of the Tools for Cutting the Fillets and Turning the Crank-pins

The other end of the crank-shaft is clamped at the turned journal in a split bearing in the tail-stock fixture. This fixture carries two hardened and ground bushings which are spaced the exact center distance of the crank throws; these bushings are alternately used as journals on the special tail spindle.

The tail-stock carries immediately in front of the main spindle, an auxiliary spindle, which is spaced the same distance apart as the journals in the fixture. This auxiliary spindle may be readily withdrawn by the lever shown on the tail-stock and serves a double purpose. In addition to affording a convenient means for changing the tail-spindle from one bearing to the other, it provides a means for accurately locating the tail fixture with relation to the crank throws when chucking. The alignment of the crank is accomplished by this auxiliary spindle in connection with a locking pin shown under and behind the face-plate (see Fig. 3) which enters a bushing in the head-stock.

The carriage is clearly shown in Figs. 2 and 3. The tool blocks are cast in one piece on a long slide which is mounted directly on the carriage. The rear tool block carries two tools set the proper distance apart for turning out the fillets, while the front block carries a round nose tool for removing the stock between the fillets. The movement of these tools is controlled by the stops shown on the slide, which enable the operator to duplicate diameters.

The longitudinal feed of the apron is controlled by the multiple stop-bar shown on the front of the bed in Fig. 1. The notches in this bar, which are spaced the same distance apart as the throws on the crank, engage a stop lever on the apron. In operation the carriage is, in turn, run up against each of these stops, bringing the back tools into exact position for turning out the fillets. The carriage is then returned, the front tool is run in, and the automatic feed is engaged. When the stop lever strikes the notch on the bar it operates a clutch on the feed rod and automatically throws out the feed. For crank-shaft work the stop bar is made as here shown to reduce the setting up time. When this feature is applied to a regular lathe, the stops are made independent, so that they may be set at any desired point within the range of the carriage travel.

This construction affords a convenient method for turning shafts with a number of shoulders, and the manufacturers claim that on many classes of work it gives a higher production than the more complicated and expensive turret machinery, usually installed for such work.

This simplified form of heavy duty lathe is built in 16, 18 and 20-inch swings. The machine shown in the accompanying illustrations is the 20-inch size.

BERTSCH COMBINED MULTIPLE PUNCH AND SHEAR

The framework and operating mechanism for a multiple punch and for a gate shear resemble each other closely, the only difference, practically, being in the cutting tools themselves. Advantage of this fact has been taken by Bertsch & Co., Cambridge City, Ind., to develop a combined machine which has practically the efficiency of a separate tool for either of its combined functions. This combination multiple punch and shear is herewith described and illustrated.

The frame is of the gate type, having a wide cross-head operated by eccentrics at either end. The main shaft bearings are provided with adjustable split boxes; a third center bearing of patented construction is also employed, as shown. The clutch is reliable, positive, noiseless and easily operated. It has steel-faced jaws and a cast-steel switch ring, acting against a hardened steel roller on a vertical steel plunger.

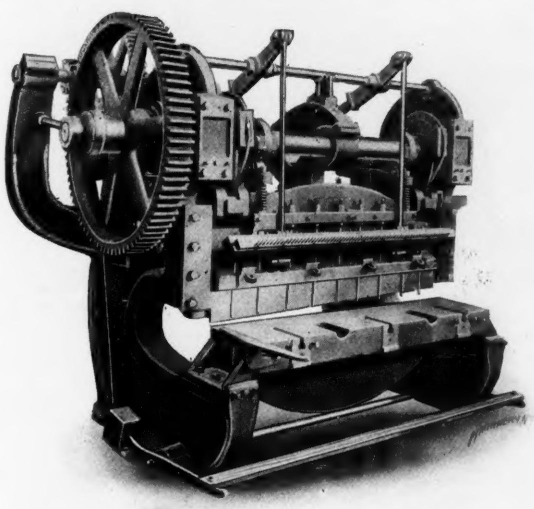


Fig. 1. Combined Punch and Shear as arranged for Plain Shearing

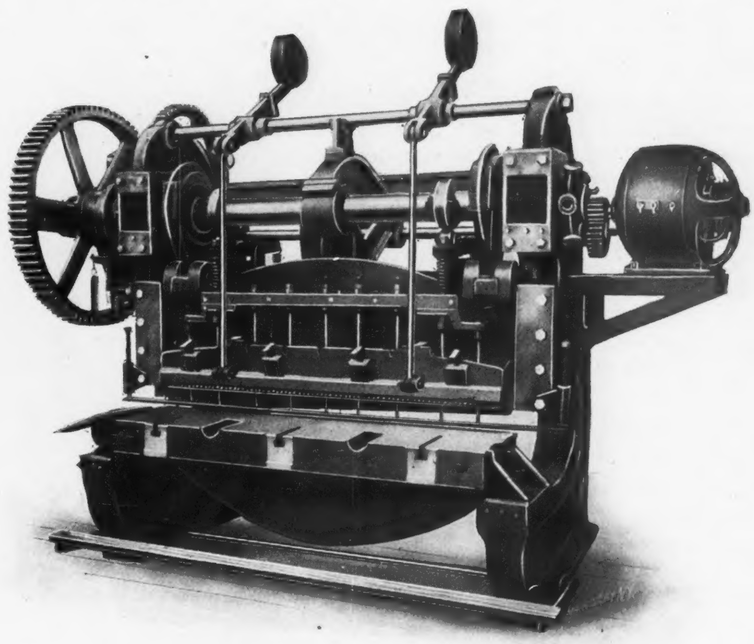


Fig. 2. Combined Machine with Cross-head swung down into Position

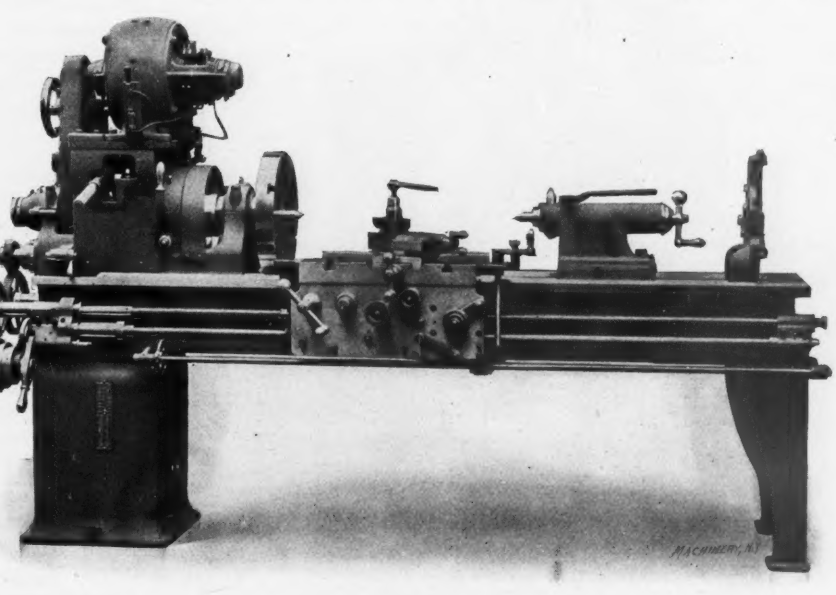
The machine is shown in Fig. 1 set up for use as a shear, and in Fig. 2 with the multiple punches in position. The latter, it will be seen, are mounted on a supplementary cross-head, hinged to the main cross-head, allowing them to be swung down into position or raised at will. Counterbalance weights are provided to facilitate this change. When engaged, this supplementary or punch cross-head is securely locked, and has a square shoulder fit along the entire length of the main cross-head which takes all the strain, none being transmitted to the hinge pins. End bearings are also provided for locating it longitudinally. The punches have either independent or universal adjustment. In the latter case they are set in an adjustable dove-tailed, steel punch-holder bar, so that the entire lot can be removed or replaced together. The punch and shear may be used together for piercing holes and trimming at one operation. The tool may be used as a simple shear as shown in Fig. 2, or as a punch only, with the upper shear blade removed.

A mechanism is provided which operates as a stripper when punching, and as a positive hold-down when shearing. This mechanism is operated by two cams mounted on the main shaft near the eccentrics. These bear down on rollers mounted on rock-shafts connected through the springs and rods shown, with a frame carrying a number of vertical rods. These latter serve as hold-downs for plain shearing work, and are of such construction as not to obscure the vision of the operator. They are of material assistance in safeguarding him when working on narrow strips. These rods also serve to support the stripper bar, as shown in Fig. 2, when punching is being performed.

This machine is made in a variety of sizes ranging from 3 feet to 12 feet in length, and with maximum capacities of 14 gage to ½-inch plate. It will be furnished for either belt or motor drive.

BRADFORD 16-INCH MOTOR-DRIVEN ENGINE LATHE

The accompanying illustration shows a regular 16-inch by 8-foot Bradford engine lathe as built by the Bradford Machine Tool Co., Cincinnati, Ohio, provided with individual motor drive. In applying the motor drive, the head-stock has been practically re-designed and adapted for the special requirements presented. The motor is placed on a frame which encloses the head-stock gearing. This arrangement is of special advantage as it puts the motor in a place where it is out of the way, makes it part of the machine, and at the same time makes it easily accessible to the operator. The connection between the motor and the lathe head-stock is through spur gears. The motor is of the 2 to 1 variable speed type, and as three speeds can be obtained by means of the gearing in the head-stock when the back-gearing is not thrown in, and three speeds with the back-gearing in operation, twelve speeds in all can be obtained. By using a rheostat, any intermediate speed from the lowest to the highest is also obtainable. The lathe is provided with a friction drive for the direct gear speeds, and a positive clutch for the back-gear speeds, and



Sixteen-inch Motor-driven Engine Lathe built by the Bradford Machine Tool Co., Cincinnati, Ohio

either can be thrown in while the lathe is in motion without danger of breakage. The motor speeds are operated by means of the smal lever at the right-hand end of the apron. The controller is inclosed in the cabinet leg of the lathe and is connected through sprockets, a splined shaft and bevel gearing with the lever which is operated over a graduated dial attached to the apron, as shown in the illustration. This arrangement makes all the controlling parts easy of access; at the same time, means are provided for stopping the lathe mechanically if required, independently of the electric equipment.

The lathe is in all other respects the same as the regular type of the Bradford lathes. The swing over the bed is 16¼ inches, the swing over the rest being 9 inches, and over the carriage 10¾ inches. The lathe with an 8-foot bed illustrated herewith takes 4 feet 1 inch between centers. A 1 11/16-inch hole is provided through the spindle. The spindle speeds obtainable vary from 5 to 340 revolutions per minute. The motor is 2 horse-power, but any style or make of motor can be fitted, if required; the speed of the motor can be varied from 600 to 1,200 revolutions per minute. The lead-screw has four threads per inch, and the lathe cuts threads from 2 to 40 per inch, including 11½ threads per inch. The weight of the lathe having an 8-foot bed, as illustrated, without motor, is 2,600 pounds net.

WELLS MOTOR-DRIVEN AUTOMATIC SCREW MACHINE

The accompanying illustrations, Figs. 1 and 2, show an automatic screw machine with individual motor drive, placed on the market by the F. E. Wells & Son Co., Greenfield, Mass. This machine is, in general, of the same design as the regular automatic screw machine built by the company, including the patented method of camming, and independent cross slides. In addition, however, this machine is provided with the advan-

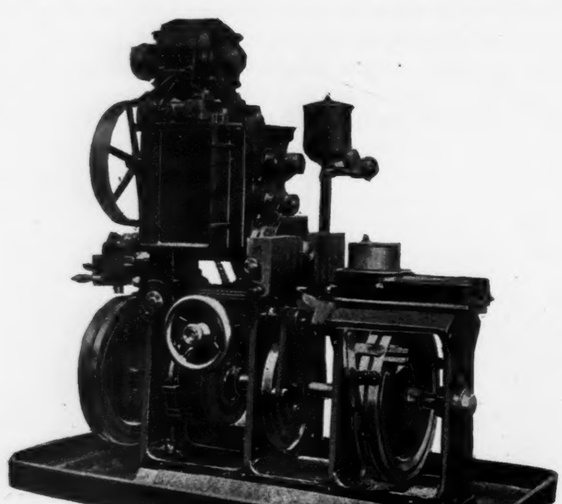


Fig. 1. Front View of Motor-driven Automatic Screw Machine, built by the F. E. Wells & Son Co., Greenfield, Mass.

tage of direct motor drive, the power being transmitted through a speed changing device, involving the use of sliding gears, by means of which three changes of speed for the spindle are obtainable. The change gearing is shown in the rear view, Fig. 2. This speed changing device can, of course, also be used for driving the machine directly from a pulley on the main line-shaft by belting directly to the pulley which is now driven from the motor; the same number of speed changes are then obtainable. The advantage of being able to easily change the speed enables greatly increased production on an automatic machine.

Another novel feature is the method of transmitting the power from the motor to the main driving pulley without appreciable loss through the slipping of the belt. This method has been used for some years past on some classes of woodworking machinery, but has not been in vogue on metal work-

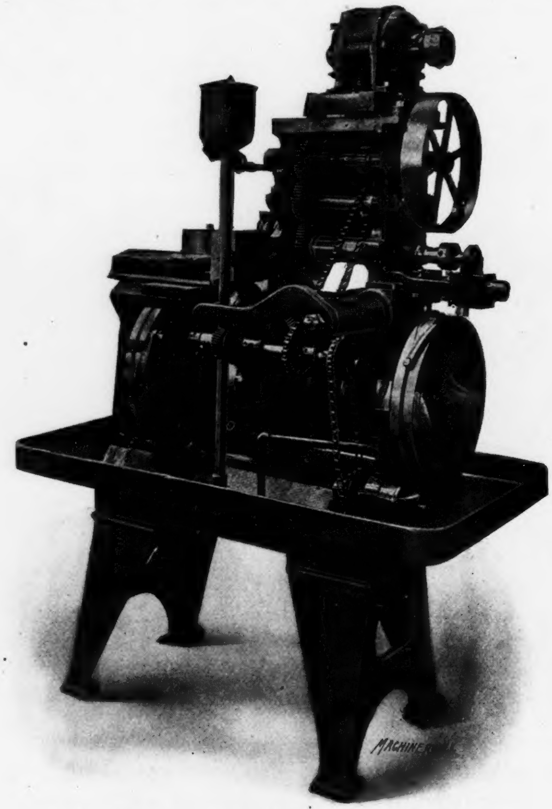


Fig. 2. Rear View of Wells Automatic Screw Machine, showing Driving Mechanism

ing machines. Pins are set into the small driving pulley on the motor and the driving belt is provided with small corresponding holes. This prevents the belt from slipping when running over the small pulley, although the center distance between the two pulleys is small and the difference between their diameters marked.

AMERICAN TWO-FOOT AND THREE-FOOT RADIAL DRILLS

In the April, 1909, issue of MACHINERY, a 2-foot sensitive radial drill, built by the American Tool Works Co., 300-350 Culvert St., Cincinnati, O., was illustrated and described. This machine has proved very popular, and the firm has been forced, on account of the large demand, to bring out special designs of this drill in addition to the original design previously described. In Fig. 1 is shown one of these special designs, illustrating the 2-foot radial drill provided with motor drive and tapping attachment. As will be seen from the illustration, a Lincoln variable speed 3 to 1 motor is mounted beneath the box table. The speeds of the motor vary from 525 to 1,575 revolutions per minute, and the motor is under perfect control of the operator by a hand-wheel shown conveniently placed under the table in front of the motor. The tapping attachment is directly connected with the main belt drive and is controlled by the lever shown at the base of the column. The arrangement of the belting from the driving pulley in the rear at the left-hand side of the machine, to the vertical driving shaft is of particular interest, providing as it does on the one hand a convenient drive in a case where short center distances and the angularity of the drive make the arrangement rather difficult, and on the other a simple drive for the tapping attachment. It will be noted that there are no gears in this drive, either at the base or at the top of the machine, the power being transmitted throughout by belts. Means are provided for regulating the tension of the belts both overhead and below. The frictions in the tapping at-

tachment are of the American Tool Works patented type, and cannot become disengaged accidentally after they have once been thrown in. They are of ample proportions to transmit the maximum power the machine is intended for. The machine has a capacity for high-speed twist drills up to 1-inch diameter, and 1-inch standard taps. It may be fitted with a tapping chuck, making it particularly adapted for tapping small holes. The general design of the machine in all other details is identical with that described in the April, 1909, issue.

In Fig. 2 is illustrated the 3-foot American radial drill mounted on a pedestal base and not equipped with a box table.

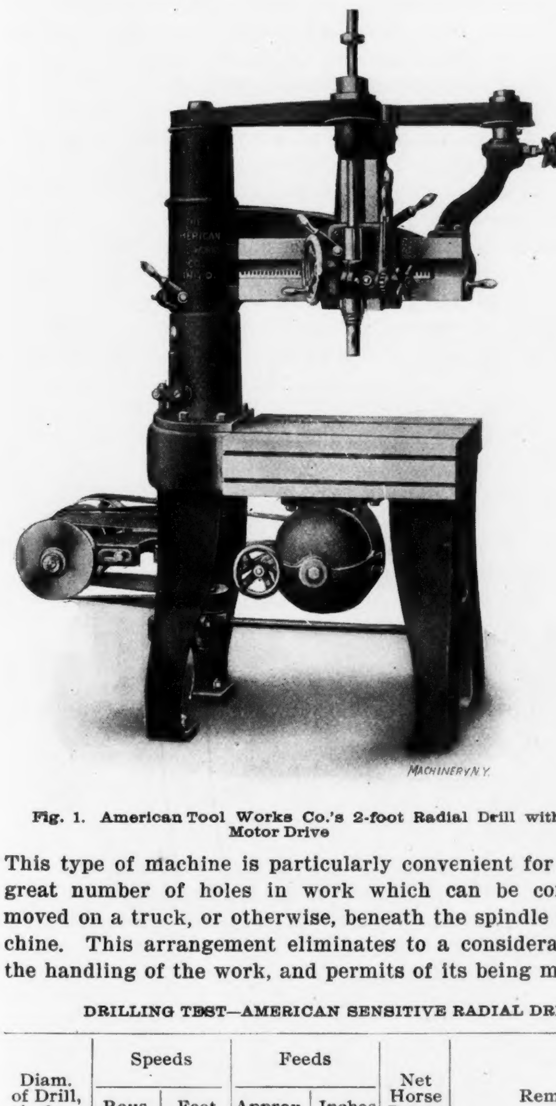


Fig. 1. American Tool Works Co.'s 2-foot Radial Drill with Motor Drive

This type of machine is particularly convenient for drilling a great number of holes in work which can be conveniently moved on a truck, or otherwise, beneath the spindle of the machine. This arrangement eliminates to a considerable extent the handling of the work, and permits of its being moved from

DRILLING TEST—AMERICAN SENSITIVE RADIAL DRILL

Diam. of Drill, inches	Speeds		Feeds		Net Horse Power	Remarks
	Revs. per min.	Feet per min.	Approx. per Rev.	Inches per min.		
$\frac{1}{4}$ C.	900	59	......	......	0.15	Cast iron 1" thick
$\frac{1}{2}$ H.S.	900	137.2	0.022	20	1.50	Cast iron 1" thick
$\frac{5}{8}$ H.S.	900	147.2	0.013	12	3.0	Cast iron 1" thick
$\frac{3}{4}$ H.S.	900	177	0.013	12	3.7	Cast iron 1" thick
1 H.S.	455	119	0.0066	3	2.6	Cast iron 1" thick
1 H.S.	785	207	0.0076	6	3.2	Cast iron 1" thick
$\frac{1}{2}$ H.S.	900	137.2	0.037	16.8	1.2	Aluminum engine frames*
$1\frac{19}{64}$ H.S.	745	248	....	......	0.9	Aluminum case†

* ½" thick. Drilled 14 holes in 25 seconds
† Drilled from the solid. Bosses drilled and faced in one operation

the drilling department to the next department with the least possible delay. The machine will be found of particular advantage in automobile and gas-engine manufacturing plants, and it is due to the requirements of manufacturers of this class of machinery that this type has been designed. When drilling with a jig the work can be carried out very rapidly, as the arm is easily swung to any position desired and the head rapidly moved to any point along the arm. A spindle speed as high as 900 revolutions is available, but this may be increased or diminished to suit special requirements. The bearings are all of the ball-bearing type, and the drill will run up to a speed of 2,000 revolutions per minute without signs of distress, but of course no twist drill would hold its edge long at such a speed.

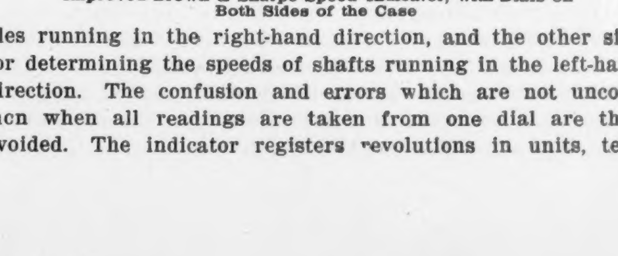
In its general details the design of this machine is identical with the 2-foot drill, excepting, of course, that the dimensions are proportionately larger. The two machines illustrated show interesting examples of the possibility of adapting standard machine tools, built on the unit plan system, to different requirements by simply changing some of the details.

Fig. 2. Sensitive 3-foot Radial Drill, especially adapted for Automobile and Gas Engine Manufacture

The accompanying table gives some results obtained in drill tests undertaken with this machine. The table gives the diameter of drill, the revolutions per minute, the cutting speed, and the feeds per revolution and per minute, stating as well the horse-power required for driving.

BROWN & SHARPE SPEED INDICATOR

A new speed indicator has been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. The new indicator is provided with two features which, in particular, will make it valuable. In the first place the indicator is equipped with a dial for registering the speed, on either side of the case. One side is used for ascertaining the velocity of shafts and spindles running in the right-hand direction, and the other side for determining the speeds of shafts running in the left-hand direction. The confusion and errors which are not uncommon when all readings are taken from one dial are thus avoided. The indicator registers revolutions in units, tens



Improved Brown & Sharpe Speed Indicator, with Dials on Both Sides of the Case

and hundreds. The second feature of importance is a small knurled wheel on the side of the case which provides a means for quickly readjusting the device after the reading has been taken. This wheel when turned revolves the disk indexing hundreds back to the starting point. This feature is of value when a series of readings is to be taken, as it saves a considerable amount of time and makes rapid and exact readings possible.

The indicator is small and light and provided with a polished wooden handle. The working mechanism is encased, and protected from dirt and injury by a heavily nickel-plated cover having a dull finish. The point is of hardened steel, and can easily be removed when worn, and replaced if required.

GORTON HEAVY-DUTY CUTTING-OFF MACHINE

A heavy-duty cutting-off machine has recently been placed on the market by the George Gorton Machine Co., of Racine, Wis. As may be seen by referring to the illustration of the machine, Fig. 2, it is exceedingly stocky and rigid in its design, and the aim of the builders has been to produce a tool capable of feeds and speeds heretofore unattainable. The bed and cutter head are both exceptionally massive, and chatter and vibration, which are inevitable in improperly designed machines of this type, have been eliminated. In addition to the rigidity, the large diameter of the main driving gear and the directness of the drive add largely to the efficiency of the tool.

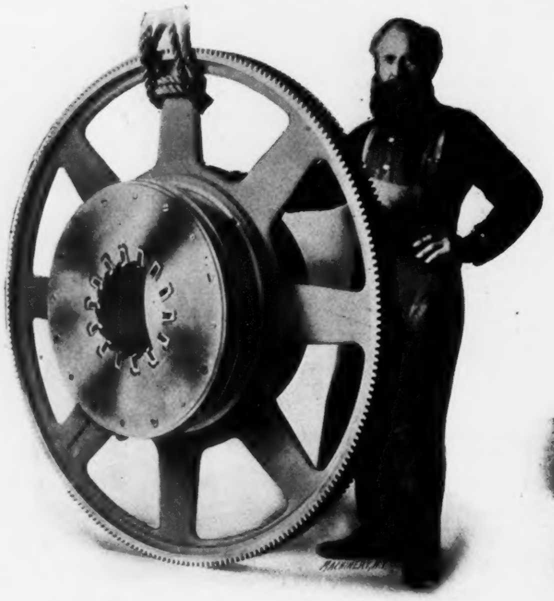


Fig. 1. Main Driving Gear of the Gorton Cutting-off Machine

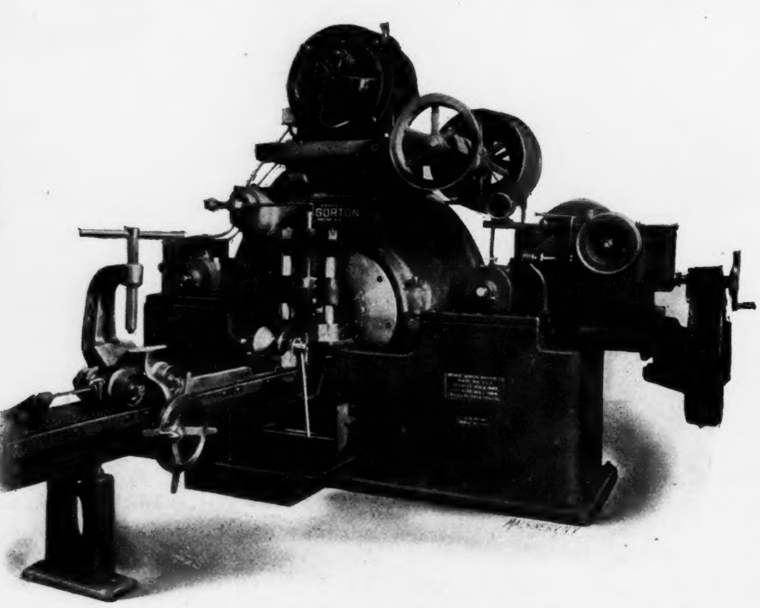


Fig. 2. Heavy-duty Cutting-off Machine, built by the George Gorton Machine Co.

The bed is a one-piece casting, heavily ribbed internally, which has its entire bottom cast solid, thus forming a reservoir for the cutter lubricant. Mounted upon this bed is a heavy cutter slide which contains the large driving gear, shown in Fig. 1, to which is attached the cutter blades and cutters. The cap which forms the upper half of the large drum bearings for this main driving gear, is bolted to the slide as shown. Cast integral with this cap are the brackets for the motor, and at the left are located the bearings for the main driving pinion which meshes with the main driving gear. The pitch diameter of the main gear is 60 inches and its face width 3½ inches, while the pitch diameter of the driving pinion is 5 inches and the face width 4 inches. The driving pinion is forged integral with its 3-inch crucible steel shaft, and the angle of the drive is such that comparatively little pressure is placed on the cutter drum bearings. Attached directly to this cutter drum, which is made of fine-grained metal (25 per cent steel), is the cutter blade of 0.60 carbon steel. This cutter blade fits accurately over ten hardened and ground steel studs which are driven into the drum, and it is additionally secured by ten ⅞-inch special screws as shown. For belt-driven machines, the driving clutch pulley is mounted directly upon the main pinion shaft. The lever which operates this clutch is seen at the front side of the machine directly over the stock vise. It is connected with the cone which expands the clutch by a rod passing through the pinion shaft, which is hollow. When the machines are electrically driven this clutch pulley is replaced by a clutch gear. The lever by which the clutch is operated is used to start and stop the machine.

This machine is designed for cutting off round stock from 1½ to 6 inches in diameter, and square bars with widths from 1½ to 5½ inches. If necessary, round stock up to 8 inches in diameter may be severed by back feeding 2 inches by hand. The bars are held in the powerful clamping vise shown, which is equipped with hardened tool steel jaws. In addition to this vise there is a trolley for supporting the outer end of the bar. This trolley runs on a track, consisting of two 7-inch channels, which on a standard machine is 22 feet long. If required, special tracks 32 or 42 feet in length will be furnished. The trolley is provided with a positive measuring arrangement which permits the stock to be cut off to the required lengths. When a piece is severed it is forced through a trough at the rear into a truck, onto the floor, with little effort on the part of the operator.

The feeding mechanism on the standard machine is driven by 7-step cone pulleys, and a change of feeds is available which ranges from 1½ to 6 inches per minute. It has been the experience of the makers that this method of driving is preferable to the all-geared drive. The lower cone pulley is connected with a gear-box containing forward and quick return feed clutches which are operated either by hand, or automatically with a positive knock-out at the extremes of the stroke, adjustment being provided for various diameters of stock.

Particular attention has been given to all lubrication details throughout the machine. The large cutter drum bearings which are of lumen bronze and interchangeable are flooded with oil, which is delivered into cored ways on the inside of the upper drum cap. The box-shaped extension for this oil may be seen just above the cutter blade, and in it there is a removable felt pad through which all oil entering the bearings must filter. This provision insures a lubricant which is free from grit. The main pinion bearings are equipped with a ring-oiling device, and are also flooded from the main driving gear. All the mechanism in the upper front gear case operates entirely below the surface of the oil.

Three standard cutter blades of different thicknesses are carried in stock, all of which are interchangeable. One of these blades is 7/16 inch thick, contains twelve 7/16 inch high-speed cutters, and is adapted for work ranging from 4 to 6 or even 8 inches in diameter. For cutting off stock ranging from 2 to 6 inches, a blade ⅜ inch thick is recommended; this contains fourteen ⅜ inch high-speed cutters and is the blade furnished with the machine unless otherwise specified. For smaller stock than that mentioned, a blade ¼ inch thick is provided

which contains sixteen 1/4 inch high-speed cutters. If necessary, even this light blade can be used for severing stock up to 8 inches in diameter, but it will not stand the heavy feeds possible with the heavier blades. With each size of blade a cutter-setting gage is furnished for setting the re-ground cutters uniformly. It requires less than one minute to remove a broken cutter from the blade and replace it with a new one, and the breaking of a cutter while the machine is in use does not injure the blade.

The lubricant for the cutters is delivered by means of a geared pump, shown on top of the upper gear case. As a copious supply of lubricant should be used, the machine is equipped with a nozzle which will deliver a stream about four inches wide and one-quarter inch thick directly onto the saw cut. The chips fall on suitable screens which are contained in the chip pans shown in the side openings of the base. These screens effect the separation of the cutter lubricant from the chips which are raked from them into pans on the floor. All the collars, levers, hand-wheels, yokes, etc., on this machine are of steel, and all the nuts and screws are finished and case-hardened. The parts are all interchangeable, and the makers guarantee the workmanship and finish equal to that of the best machine tools built.

MECHANICS' MACHINE CO.'S 20- AND 26-INCH UPRIGHT GANG DRILLS

The accompanying illustrations show two sizes of upright gang drills brought out by the Mechanics' Machine Co., Rockford, Ill. In Fig. 1 is shown what is known as the 20-inch gang drill. In this, the individual drill heads with their frames, cone pulleys and gearing are mounted on a box column as indicated, the drills being built in gangs of 2, 3, 4, 5 or 6 spindles. Each drill is independent and can be stopped, started, or its speed changed, without interfering with the

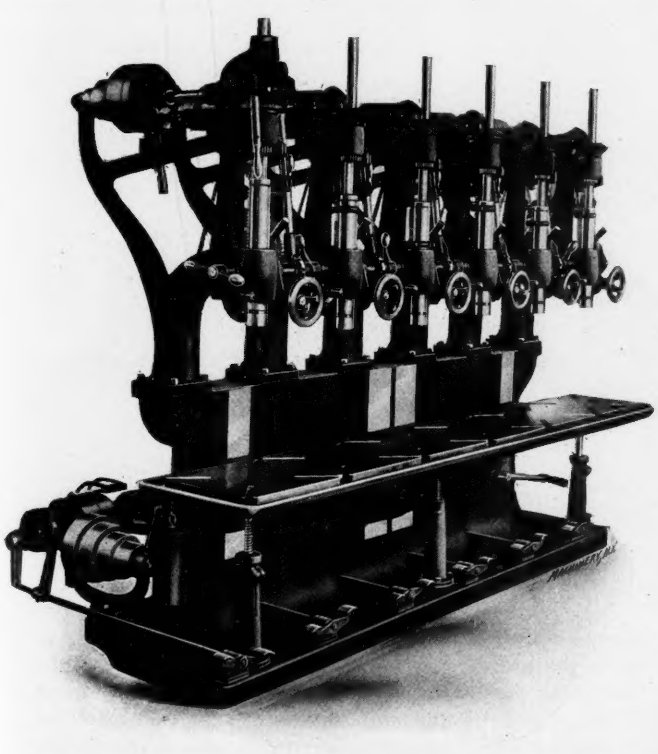


Fig. 1. Twenty-inch Six-spindle Gang Drill, built by the Mechanics' Machine Co., Rockford, Ill.

other drills, each having its own individual counter-shaft, operated through a foot lever, shown in the front of the machine. The work table slides on ways on the main column, and is supported on its edge by adjusting screws as indicated.

The maximum height of the drill with the spindle in its highest position is 84 inches, and the minimum height 75 inches. The distance from center to center of the spindles is 16½ inches, and the distance from the center of the spindle to the column is 10½ inches. The spindle, which is provided with a No. 3 Morse taper, has a diameter of 1⅜ inch and a vertical travel of 11 inches, and the spindle speeds are 0.005, 0.008, 0.011 and 0.014 inch per revolution of spindle. The size of the planed surface of the table for a 2-spindle machine is 14½ by 32½ inches, with an additional 16½ inches in length for each spindle added. The vertical travel of the table is 13 inches, and the maximum distance from the spindle to the table is 26½ inches, the minimum distance being 4 inches. The floor space required for the 2-spindle drill is

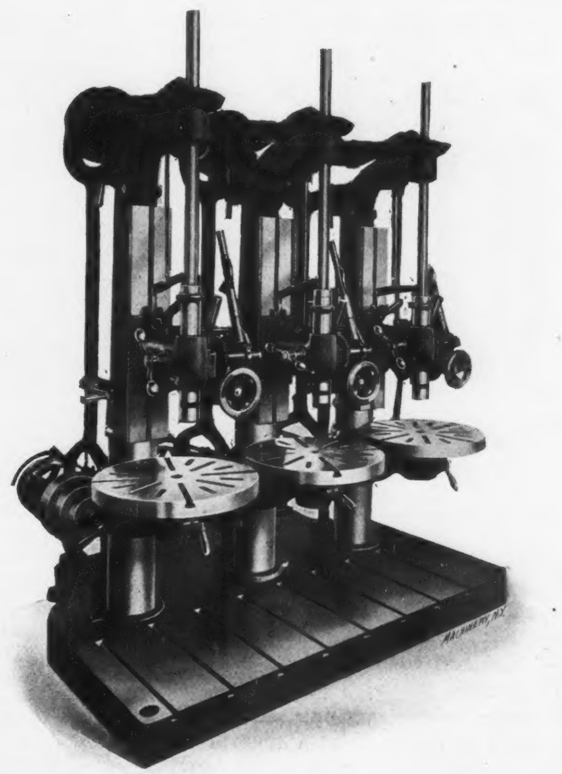


Fig. 2. Twenty-six inch, Three-spindle Gang Drill

55 x 34 inches, for a 3-spindle drill 55 x 51 inches, an additional 17 inches in length being required for each spindle added. The weight of the 2-spindle machine is 1,900 pounds net, with an approximate addition of 800 pounds for each spindle added.

The 26-inch gang drill in Fig. 2 is, as shown, of different design, it consisting of several practically complete upright drills mounted on a common base-plate. The design of the individual drills is also different from the design of the smaller drills shown in Fig. 1, these drill presses having sliding heads as indicated in the illustration. The 26-inch drill is supplied in gangs with 2, 3 or 4 spindles on the same base, and is furnished either with the ordinary round tables shown in the illustration, or with square tables having an oil groove or receptacle around the edges. These drills are furnished with back-gearing and positive feed; a geared tapping attachment or friction clutch tapping attachment can be furnished with one or more spindles, as required.

The maximum height of the 26-inch drill press with the drill spindle in its highest position is 87 inches; the maximum distance from the spindle to the base is 50 inches and the minimum distance 17 inches. The maximum distance from the spindle to the individual round table is 37 inches, the spindle being capable of reaching completely down to the table when in its lowest position. The distance from the column to the center of the spindle is 13 3/16 inches, the vertical feed of the spindle is 11½ inches, and the movement of the sliding head is 23 inches. The distance from center to center of the spindles is 24 inches. The floor space required for a drill press with two spindles is 48 by 67 inches, for three spindles 72 by 67 inches and for four spindles 96 by 67 inches. The net weight of the two-spindle 26-inch gang drill is 3,400 pounds, with approximately 1,700 pounds added for each additional spindle. A 24-inch and a 32-inch drill are also made in gangs, the same as the 26-inch drill. The general design of these two sizes is the same as that of the 26-inch drill.

"PEERLESS" PORTABLE ELECTRIC CHIPPING HAMMER

The electric hammer herewith illustrated and described is made by the Cincinnati Electrical Tool Co., 650 Evans St., Cincinnati, O. So far as we know, this is the first strictly electric hammer to be put on the market, there being in this tool no interposition of mechanical or pneumatic mechanism between the ram of the hammer and the source of the current.

The tool receives its current supply from an attachment connected with an ordinary direct current lamp socket. From

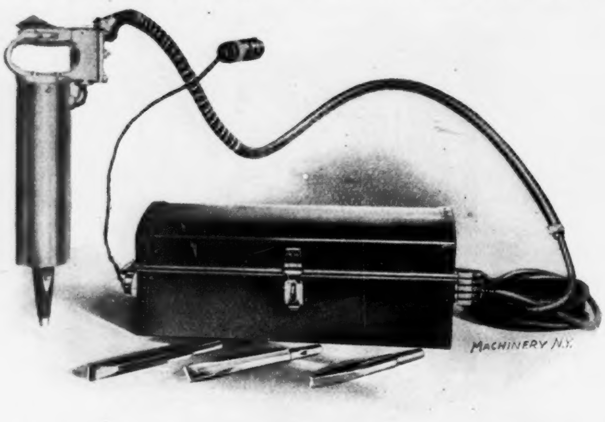


Fig. 1. An Electrically-operated Chipping Hammer, arranged with Lamp Socket Connection

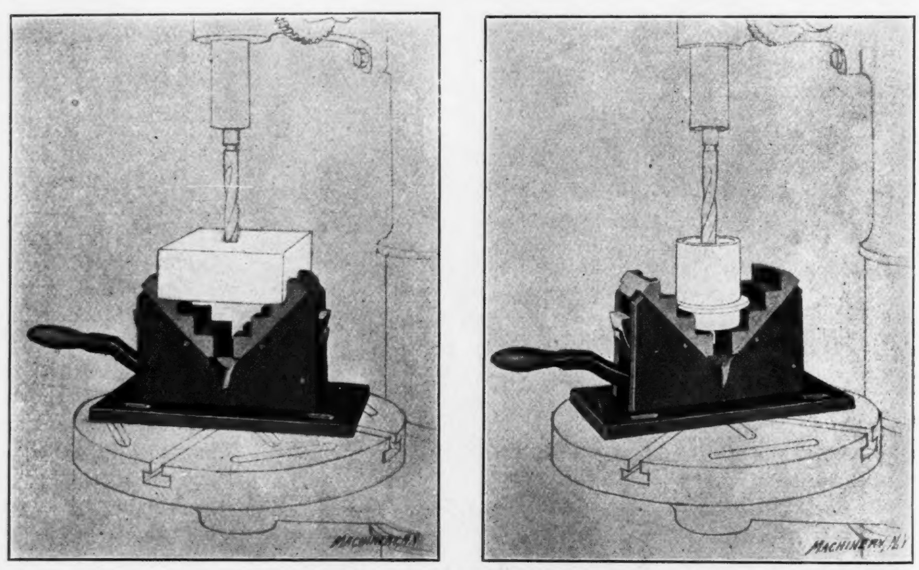
here it is led to the box shown, which contains an automatic switch mechanism for controlling the current movement throught the triple cable leading to a pair of solenoids contained within the hammer casing. When one of these solenoids is energized, the ram is raised; the energizing of the other draws the ram down again. The action of the ram or plunger on the chisel is identical with that in a pneumatic hammer. The same general appearance, and the same style of grip is retained, a switch being provided in the handle of the tool for controlling it in the usual manner.

The device is light enough so that it can be carried around the shop by a boy. The box containing the switch weighs 38 pounds, and the hammer 19. The former takes a space of 7½ by 20 inches. The hammer itself is 14¾ inches long by 3½ inches in diameter. It will cut armor-plate up to ½ inch thickness.

MITCHELL-PARKS DRILL PRESS VISE

The accompanying illustrations, Figs. 1 and 2, show the general design and action of a new drill press vise brought out by the Mitchell-Parks Manufacturing Co., 612 So. 6th St., St. Louis, Mo., and known as the "Gravity" vise. The device has been designed with a view of producing a drill press vise which would be extremely simple and rapid in its operation and that would, at the same time, hold the work being drilled firmly, and which could be used on work of any size or shape. The whole vise consists of only five parts and is not provided with springs of any kind, nor does it require any special parts for special work. When the handle shown in the illustrations is raised, it brings the jaws resting on the angle guides to which they are fitted, apart. A maximum opening between the upper steps of the jaws of 8 inches and between the lowest steps of the jaws of 2½ inches can be obtained. When the work is placed in position between the jaws, its weight forces them downward along the guides, so that a firm hold is obtained on the work. When the drill enters the work, the pressure of the drill forces the jaws still further downward, and the work is gripped tighter the greater the pressure exerted on it by the drill. The jaws can therefore be said to automatically clamp the work as soon as it is placed in position. At the moment when the drill passes through the work, and the pressure of the drill on the work thus is decreased, a slight pressure on the handle will hold the work tightly so as to prevent turning at this time. Raising the handle will release the work between the jaws.

The vise may be placed loose on the drill press table except in extreme cases. When required, however, it can be easily bolted to the drill press table by means of the slots provided in the base plate of the device. The vise will hold round work from ½ inch up to 8 inches in diameter, and work of other shapes in the same proportion. The size of the base plate of the device is 7½ by 14 inches.



Figs. 1 and 2. The Gravity Vise, made by the Mitchell-Parks Mfg. Co., St. Louis, Mo.

MILWAUKEE SIXTEEN-INCH LATHE

In the June, 1908, issue of MACHINERY a lathe built by the Milwaukee Machine Tool Co., Milwaukee, Wis., was illustrated and described. The accompanying half-tones and line engraving show an improved design of the company's 16-inch lathe, recently placed on the market. In designing this lathe particular attention was given to provide an even distribution of metal, and an effort has been made to place the metal wherever it will do most good. Careful attention has also been given to produce a high-grade lathe as far as materials and workmanship are concerned. The lathe is especially adapted for general manufacturing purposes, it having the strength and power necessary for heavy work, and at the same time provision is made for convenience and adaptability for lighter jobs. The bed is heavier than in the previous designs, and is reinforced throughout with heavy cross ribs. The V's, which are planed at an angle of 45 degrees, have large wearing surfaces. The alignment of lead-screw and feed-rod has been taken care of when planing the bed, the bearing pads for these parts being planed and grooved to templets, the bearings being carefully fitted to the bed.

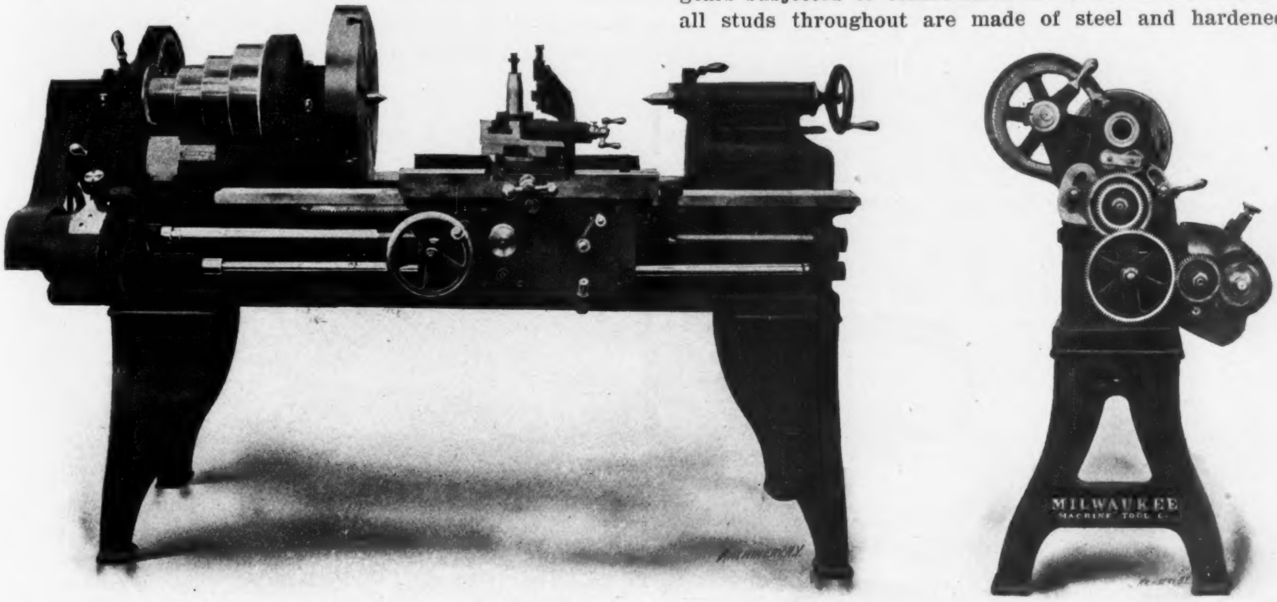
The Head- and Tail-stock

The design of the head-stock has been improved, it being more massive. The cone pulley has four steps instead of five as in the previous design, the width of each of the steps of the pulley having been correspondingly increased in order to permit a sufficient amount of power to be easily transmitted to the machine. The back-gearing is also made correspondingly heavy and of higher ratio. A patented spring cone stop is located in the face-gear and makes it very convenient for the operator when changing from the open belt speed to the back-gear drive. The spindle is provided with a 1 9/16-inch hole through its entire length and is drilled from the solid. It is made from crucible steel containing 0.60 per cent carbon, and is accurately ground. The bearings for the spindle are large, and are made of phosphor bronze and scraped to a bearing by hand. Two large oil reservoirs are located directly beneath each bearing, and the oil is carried to the spindle by means of a wick, which, on the one hand, keeps the spindle constantly wiped free from grit and dirt, and on the other hand affords ample lubrication regardless of speed.

The tail-stock is of correspondingly heavy design and has a long bearing surface on the bed. It is designed so as to permit the compound rest to be turned at an angle of 90 degrees, even when turning the smallest diameters. Screws are provided for setting it over sideways for taper turning, if required. The diameter of the tail-stock spindle is two inches, and the centers are provided with a No. 4 Morse taper.

and both slides are provided with taper gibs for adjustment, thereby avoiding the necessity of manipulating more than one screw when adjusting the gib. Graduated feed collars are provided for the feed screws for both the cross-slide and the compound rest.

The apron is carefully brazed and is tongued-and-grooved into the carriage and securely bolted to it. All pinions and gears subjected to considerable strain are made of steel, and all studs throughout are made of steel and hardened and



Figs. 1 and 2. Side Elevation and End View of Milwaukee Machine Tool Co.'s Improved 16-inch Lathe

The Carriage and Apron

The carriage has a bearing of 23½ inches on the ways, and is gibbed to the bed for its entire length. The bearing surface on the bed is not recessed, but is in full contact from end to end with the entire depth of the V's. This eliminates to a great extent the difficulty met with in regard to vibrations or "chattering." Instead of an inside V on the front of the lathe a flat surface is used. This shortens the bridge of the carriage, and affords a solid bearing directly under the tool-post. Large T-slots are provided for clamping work to the carriage. The cross-slide and compound rest have been made heavy in proportion to the remainder of the machine,

ground, except in such cases where bronze bushings are provided. The rack is of steel, and cut in one piece. A safety locking device for the half-nuts is one of the features of the lathe.

The lathe is also furnished with a thread chasing dial, a feature which should be greatly appreciated. The dial is graduated to indicate the rotation of the lead-screw, and enable the operator, when cutting screw threads, to return the carriage quickly by hand, and throw in the nut at the proper moment. This feature alone saves a considerable amount of time when cutting long screw threads, as anyone having used such an attachment will appreciate.

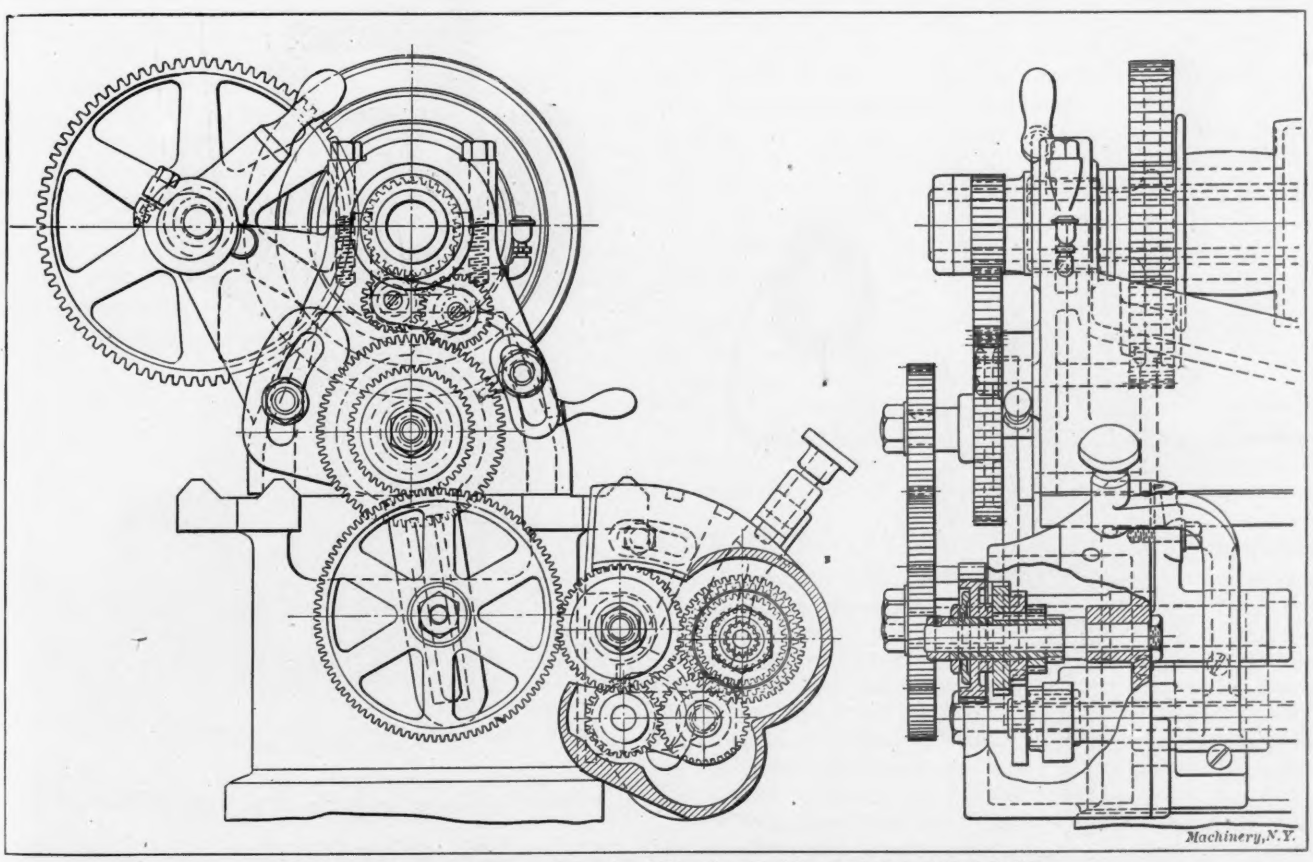


Fig. 3. Design of Feed Box and Gearing, Milwaukee Machine Tool Co.'s 16-inch Lathe

The Change Gear Box

The lathe is provided with a change gear box which gives four practically instantaneous changes of feed through the operation of one lever, as shown in Fig. 1. The drive to the gear box and its general arrangement are shown in the line engraving, Fig. 3. Through the use of change gears supplied with the machine and this gear box, a practically unlimited range of feeds and threads per inch, within the capacity of the machine, can be obtained. The construction of the gear box is very simple, it consisting merely of a cone of gears and a sliding gear which can be brought into mesh with either of the gears in the cone. A friction disk is applied to the gear drive. It is adjustable, and can give any amount of tension desired. It will eliminate to a great extent the breaking of apron parts, etc., due in many instances to carelessness on the part of the operator.

Special attention has been given to the question of gear guards, all gears in any way exposed having been properly

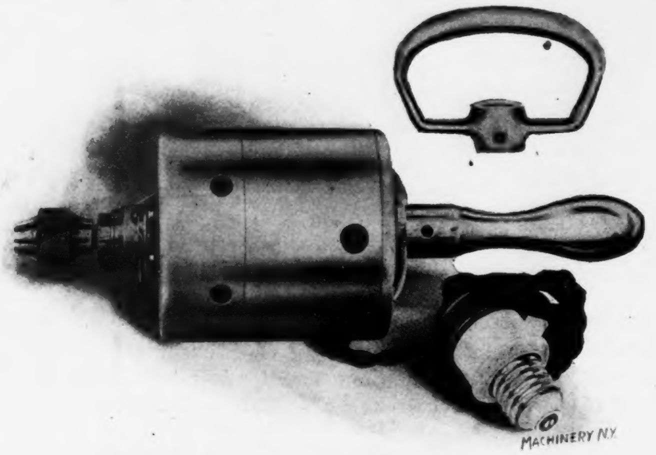


Fig. 1. "Midget" Air-cooled, Electric Drill

covered with guards. In the end view, Fig. 2, some of these guards have been removed merely in order to show the gearing, but they are well in evidence in Fig. 1. Considering the increasing requirements of the law, and the realization of the necessity of protecting the operator from possible injury, this feature is of considerable importance.

A double friction counter-shaft is supplied with the machine in which all the wearing surfaces on the clutch are

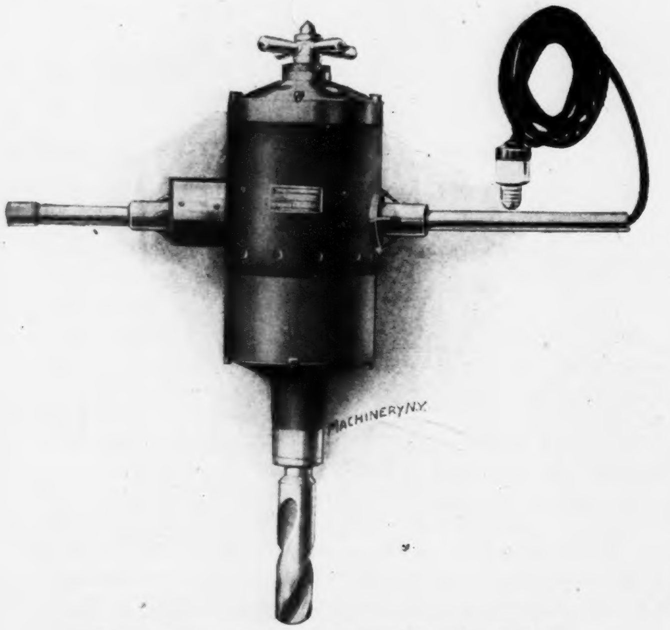


Fig. 2. Heavy Portable Drilling and Reaming Machine

accurately ground. The bearings are of the ring-oiling type, and are made of pressed steel. The hangers are made of the same material, which adds to a great extent to the strength and lightness of the construction.

The net weight of the machine with the six-foot bed is 2,200 pounds, and the approximate weight of the bed per each additional foot in length is 120 pounds.

PEERLESS AIR-COOLED PORTABLE ELECTRIC DRILLS AND GRINDERS

The tool shown in Fig. 1 (made by the Cincinnati Electric Tool Co., 650 Evans St., Cincinnati, O.) is exceptional for its lightness of weight, as compared with the size of drill it will use. Its actual weight (including the chuck) is only 4½ pounds, and it will drill holes up to 3/16 inch in steel. The style shown is made for direct current, but a similar tool is made for use with various voltages of alternating current.

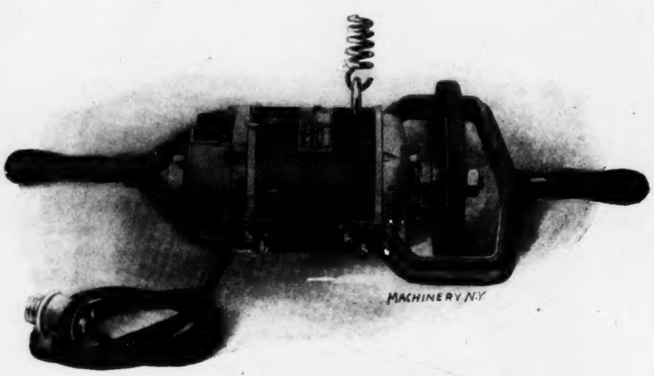


Fig. 3. A Suspended or "Aerial" Grinder for Heavy Duty

The largest size of portable drilling and reaming machines made by this firm is shown in Fig. 2. This machine is designed to drill holes in steel up to ½, 2 or 2¼ inches, depending on which of three sizes is furnished. These three tools are fitted with Nos. 3, 4 and 4 Morse taper sockets, respectively. The smallest one weighs 63 pounds and the largest 86. Twenty feet of cable are provided, the leads entering one of the handles. A quarter turn of the latter starts and stops the machine. The motor, in common with all others in this line of portable tools, is air-cooled, and can be kept under

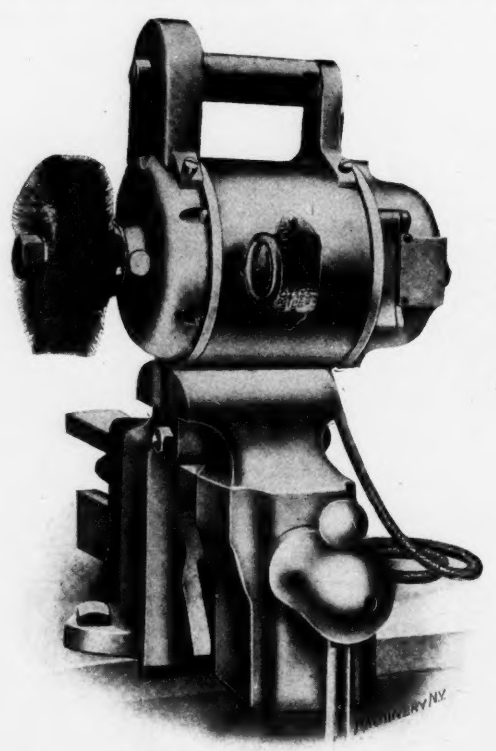


Fig. 4. A Light Aerial Grinder held in the Vise and used for Buffing and Polishing

heavy duty all day without getting heated. A fan mounted directly on the armature shaft provides the circulation for this.

The grinder shown in Fig. 3 is particularly adapted for smoothing off heavy castings. It is known as an "aerial" grinder, being hung on a spring suspension from the ceiling. The two handles hold it on the line of the center of gravity, and make manipulation of the tool easy. This direct current grinder is made in two sizes, for wheels 8 by ¾ inch and 10 by 1 inch respectively; it is furnished for alternating as well as for direct current.

Fig. 4 shows another type of aerial or portable grinder for lighter work than that done by the tool shown in Fig. 3. Here, however, the grinder has been caught in the vise, so as to make of itself a convenient bench buffing or polishing lathe. The starting switch is controlled by the knurled handle, a quarter turn of which serves to start or stop the machine.

One of the various lathe grinding attachments is shown in Fig. 5, where it is provided with an extension support and

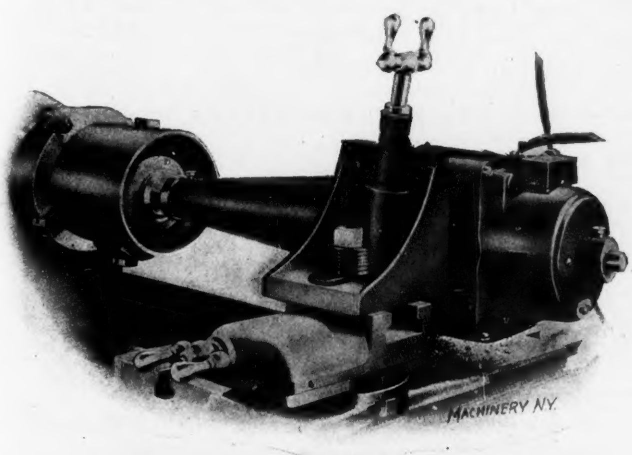


Fig. 5. Lathe Grinding Attachment, with Extended Spindle for Internal Work

spindle, particularly adapted to internal grinding. The use of such a device will bring the ordinary engine lathe into strong competition with the special grinding machine for toolroom and similar occasional work.

The various motor-driven tools just described are wound, as mentioned, for either direct or alternating current, and will be furnished for special voltages and cycles as may be required by the purchaser.

JARVIS DRAW-IN ECCENTRIC COLLET CHUCK

The accompanying half-tone shows an interesting device known as the Jarvis draw-in collet chuck, placed on the market by the Chandler & Farquhar Co., 34 to 38 Federal St., Boston, Mass. The chuck consists of a casing made in two parts, *A* and *B*, the upper part being graduated on the top surface. This casing is recessed eccentrically on the inside, and contains a cylindrical part on which worm-wheel teeth are gashed, this cylindrical part fitting in the eccentric recess of the casing, and being provided with an eccentric stem which is central with the casing when in the zero position, and into which fits

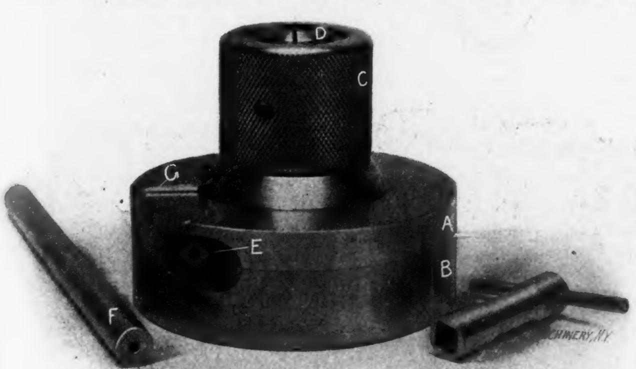


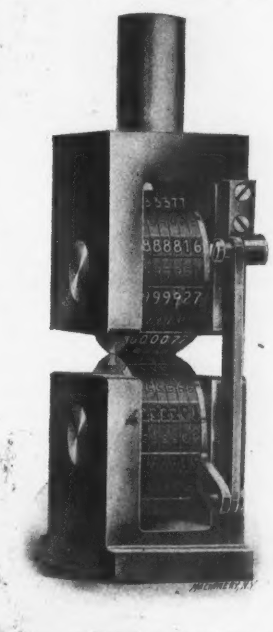
Fig. 1. Jarvis Draw-in Collet Chuck, placed on the market by Chandler & Farquhar Co., Boston, Mass.

the collet *D*. The stem is threaded on the outside, and over it fits the chuck closer *C*. The worm teeth on the eccentric disk, fitted inside the casing, mesh with a worm *E*. It is obvious that when the worm is revolved by means of a socket wrench being applied to its square head, the eccentric disk inside the casing will revolve, and will, in turn, move the collet chuck out of its true center.

The chuck will be found useful for many purposes. It can be placed either on the lathe face-plate or in a holder, and can be used for holding either the work or boring tools. It can also be used on a milling machine, grinder, or any other machine where its special features would be advantageous. It has an eccentric throw of ¼ inch from the center, and the face is graduated to read to 0.001 inch, so that it is easy to determine how much the center of the chuck will be out of its true center when the eccentric worm-gear has been turned a certain amount. A special test bar *F* is provided to be placed in the chuck in order to test when it is running true. It should, of course, be clamped to the face-plate of the lathe so that it runs absolutely true when the pointer *G* is at the zero position. If this is the case, the test bar can be removed, the work put into the chuck, the chuck moved out of center by turning the worm, and returned to an accurately central position by merely returning the pointer to the zero position. This feature will be found useful for drilling, boring or grinding eccentric bushings, or making eccentric cams. It is also useful when boring holes to size, as the boring tool can be placed in the chuck and the amount that the boring tool is fed into the work can be read off on the graduations on the face of the casing *A*. It will be found very convenient when boring jigs and fixtures in the milling machine. The chuck collets furnished have a capacity of from 1/16 inch to 1/2 inch, varying by 64ths or 32ds, as required.

BATES METAL NUMBERING MACHINE

The accompanying illustration shows one of the many types of numbering machines made by the Bates Numbering Machine Co., 696-710 Jamaica Ave., Brooklyn, N. Y. This machine is designed for embossing numbers on soft metal tags, strips, etc. The machine is operated in a power press, the upper part of it, of course, being attached to the plunger, and the lower part to the die block. It consists, as shown, of male and female dies, and can be made with 5, 6, 7 and 8 wheels, according to the number of figures required. When at work, it will number the work consecutively and automatically, there being a connecting pitman or link, as shown, between the upper and lower dies, so that they will index simultaneously. The height of the figures provided can be made either 3/16, 1/4, 3/8 or 1/2 inch, and intermediate sizes between these can be furnished if desired. The machine is an interesting example of the development of automatic numbering machines for embossing numbers on metal.



Bates Numbering Machine for Embossing Numbers on Metal

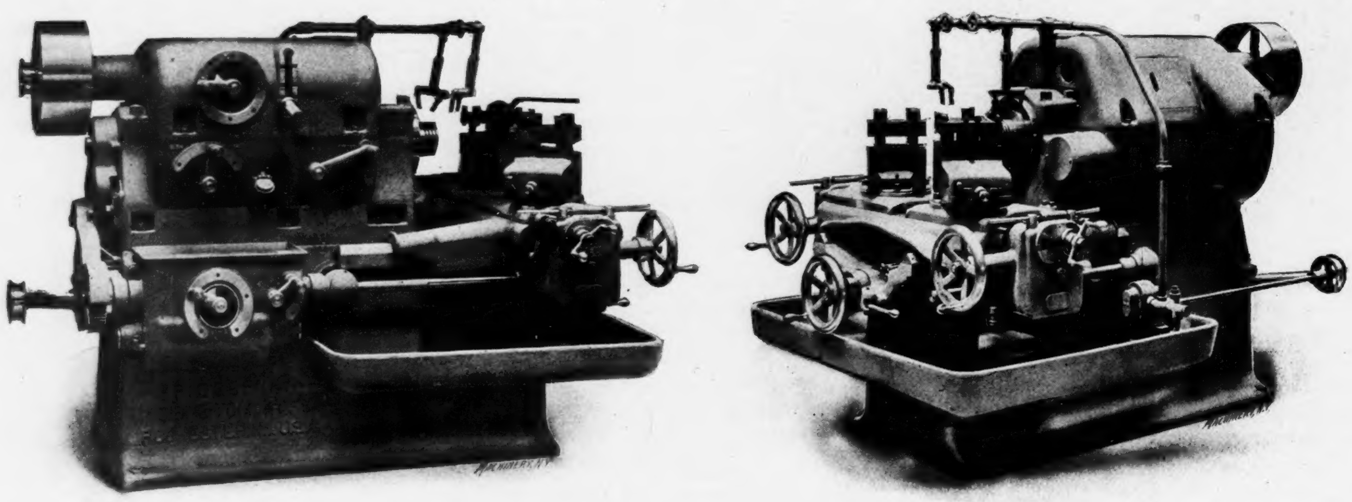
BRIDGEFORD BEVEL GEAR TURNING LATHE

In the accompanying illustrations Figs. 1 and 2 are shown front and rear views and in Fig. 3, end view, of a lathe for turning bevel gears, which has just been placed on the market by the Bridgeford Machine Tool Works, Rochester, N. Y. This machine has been designed specifically for turning simultaneously the face, front and back angles of bevel pinions and gears up to 18 inches in diameter. Besides these turning operations, the boring and the facing of the back of the gears is also done advantageously in the machine.

As will be seen from the illustrations, the frame, oil pan and oil reservoir are cast in one piece. The top of the frame or bed is provided with ways similar to those on engine lathes, and the head-stock of the machine is of a design similar to that used on the Bridgeford heavy duty geared head engine lathe, which was illustrated and described in the March, 1908, issue of MACHINERY, in the department of New Machinery and Tools. The drive to the geared head is through a constant speed pulley, 15 inches in diameter, as shown, with a width for a 6-inch belt and running at 440 revolu-

tions per minute. The gearing in the head provides for twelve spindle speeds ranging from 5.8 to 214 revolutions per minute. The design gives sufficient pulling power to enable three cutting tools to be used simultaneously, all cutting up to their full capacity. All the gears within the head are made of steel and run in oil. The bearings are self-oiling to prevent accidental heating and frictional losses.

The carriage is similar to that provided on a lathe, but is of a duplex construction, having an apron both in the front and in the rear of the machine, and is provided with two cross-slides carrying the angle turning rests, the right-hand cross-slide having a turret tool-holder. The carriage cross-slides and angle rests have power feed and automatic stops. The required hand-wheels are arranged within easy reach of the operator when in a working position. The machine is provided with a feed box as shown in Fig. 1, which gives ten feeds ranging from 0.005 to 0.190 inch per revolution of the spindle. The gears in this feed box are also made of steel and run in oil. From the feed box the power is transmitted by splined shafts to the aprons, the same as in a lathe, the power being carried to the rear of the machine by means of bevel gearing and a shaft which passes through the frame or bed. The machine is provided with an oil pump as shown in Fig. 2, and with properly arranged piping for carrying lubricant to the cutting tools. The oil pump is driven by a belt from a pulley on the end of the main driving shaft, as shown. All gearing has been carefully covered by suitable guards, and the machine offers a pleasing appearance on account of its well proportioned and uniform lines. The total net weight of the machine is 7,300 pounds.



Figs. 1 and 2. Front and Rear Views of Bevel Gear Turning Lathe, built by the Bridgeford Machine Tool Works

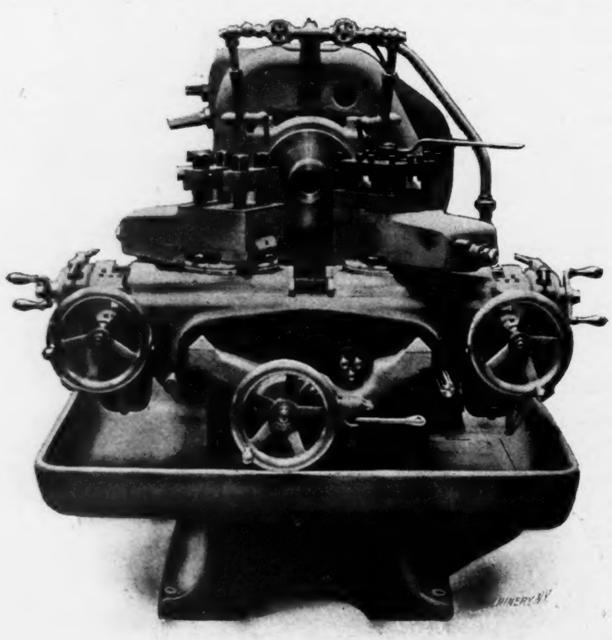
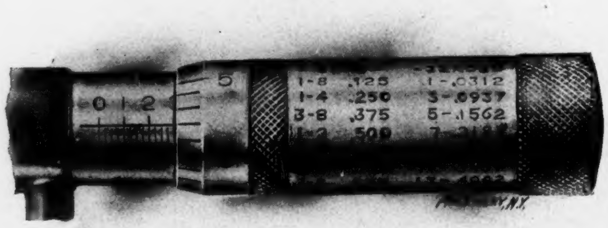


Fig. 3. End View of Bevel Gear Turning Machine

The operation of the machine will undoubtedly be of interest. The first operation consists of boring the hole and facing the back of the gear. During this operation the blank is held in a universal chuck and the hole is bored out with the tool held in the left-hand rest, while the facing is done with tools held in the turret of the right-hand cross-slide. The second operation, consisting of turning the face, front and back angles, is the one where the prominent features of the machine come more particularly into play. During this operation the blank is either held on a special hub or on an arbor in the taper hole in the spindle, which is provided with a split bushing. The left-hand turning rest carries a roughing and a finishing tool for the face angle, and the turret on the right-hand cross-slide a set of roughing and finishing tools for the front and back angles. As these tools work simultaneously, bevel gears can be finished very rapidly. Two of the machines are already in operation in a gear manufacturing plant, and have made it possible to save considerable time over that required when turning the gears with ordinary engine lathe and turret lathe methods. At the same time, more accurate work can be produced than can be done with forming tools.

DECIMAL EQUIVALENTS ON THIMBLE OF MICROMETER CALIPER

The accompanying illustration shows an improved thimble of the micrometer caliper manufactured by the J. F. Slocomb Co., Providence, R. I. The improvement consists of a complete table of decimal equivalents of eighths, sixteenths and thirty-seconds of an inch, rolled on the thimble. It should prove very handy to the machinist to have the decimal equivalents directly on the thimble, it being possible to make the figures large and distinct and easy to find and read.



Thimble of Slocomb Micrometer, with Decimal Equivalents

* * *

The seventy-fifth meeting of the British Association for the Advancement of Science was opened August 25 in Winnipeg, Canada, with 600 delegates present from the United Kingdom, the United States and Canada. The twelve sections of the association remained in session for a week. One of the principal addresses, dealing with a variety of matter of interest to scientists and scientific educators, was delivered by Sir J. J. Thompson, the president of the association.

NEW MACHINERY AND TOOLS NOTES

ADJUSTABLE WORK CLAMP: Howell & Murray, Waverly, N. Y. This is a convenient tool of simple construction for holding work on the drilling machine table. The clamp jaw is adjusted and held in position by notches on an upright which is held down to the work and table by a bolt and nut, the bolt having a square head fitting in the T-slot of the table.

HIGH-SPEED STEEL TWIST DRILL: New Process Twist Drill Co., Taunton, Mass. This drill, known as the Reliance high-speed twist drill, is made from flat bar stock twisted while hot. The twisted blade is then inserted into the tool shank, and brazed to the shank, so that the drill when finished is practically as strong as if made from one piece of steel.

AUTOMATIC SCREW MACHINE: L. Wollstein & Co., 16 John St., New York City. This machine is adapted for making small screws and other parts commonly made in automatic screw machines. Instead of a turret, however, it carries a sliding spindle for holding a drill or other tool. When external threading is to be done the spindle can be removed and an opening die of special construction put in its place.

SMALL GEAR HOBBING MACHINE: Schuchardt & Schütte, 90 West St., New York City. This machine has been designed in response to the demand for a machine to cut small gears for water meters, clocks, etc. It has a capacity for hobbing gears up to 24 diametral pitch, with an outside diameter of 4 inches and a face of 6 inches. The cutter spindle runs at 600 revolutions per minute. The machine is entirely automatic, but hand feed can be used if desired when cutting small worm gears.

RING OILING BUSHING: Brown Engineering Co., 123 North 3rd St., Reading, Pa. This ring oiling bushing for loose pulleys and clutches is particularly adapted for use in machine shops. It will run from four to six weeks without having its oil supply replenished, and it is claimed that the bushing will save over 75 per cent of the oil ordinarily required. It can be operated at speeds as high as 2,000 revolutions per minute. The bushings are made with all the standard bores from 1 3/16 inch to 2 15/16 inches.

OIL CUP: United States Metallic Packing Co., Philadelphia, Pa. This accessory has been designed with a view of making an oil cup of maximum strength. The shank of the oil cup is of machine steel, and the cover is of pressed steel, attached to the body of the oil cup by a steel chain so as to prevent losing it. It is furnished either with a needle or wick feed, and with shanks of any desired diameter and number of threads. The standard cup, however, has a ¾-inch diameter shank and 14 threads per inch.

UNIVERSAL BALL BEARINGS FOR SHAFTING: United Bearings Co., Bradford, Pa. These ball bearings are adapted for heavy loads and allow an end movement of the bearing. They consist of an outer casing proportioned to fit any standard hanger and containing a hardened and ground steel case at each end for receiving the ball bearings. The inner ball race is of hardened steel provided with a lining of good anti-friction metal fitting over the shaft. Thus the bearing is in fact a combination plain and ball bearing, so that if the ball bearing should be subjected to injury the bearing still is serviceable as a plain bearing.

BENCH CUTTING-OFF SAW: Taylor-Shantz Co., Rochester, N. Y. This machine is intended to be placed on a bench or stand, and to do the work, generally, of a power hack-saw. It is designed particularly for tool-room use. Due to the fact that a blade with a thickness of only 3/64 inch is used, considerable material is saved, which is important when cutting up high-speed steel or other expensive stock. On large work a saw 5/64-inch thick may be used. The machine weighs 160 pounds and occupies a space of 14 by 14 inches. It has a capacity for cutting off 2½ inches square, 2¾ inches round, and 4 by 2 or 4½ by 1 inch flat stock.

HEAVY SWAGING MACHINE: Langelier Mfg. Co., Providence, R. I. This machine is adapted for tapering heavy work. It swages solid stock up to 2 inches in diameter and tubing up to 3 inches, and is especially intended to meet the requirements of manufacturers of heavy tubing for the automobile trade. The machine takes dies from 4 to 8 inches long; the spindle is of large proportions, its head being 10⅝ inches in diameter by 10⅝ inches long and the bearing part 6 inches in diameter by 23 inches long. The machine should run at a speed of 240 revolutions per minute and be connected to the counter-shaft by a 7-inch belt. The floor space required is 42 by 48 inches.

SAW TABLE: Silver Mfg. Co., 317 Broadway, Cleveland, O. This machine is adapted for small pattern shops or woodworking shops on account of being inexpensive and simple. It is equipped with a safety guard and pivoted auxiliary frame for vertical adjustment of the saw, and while adapted for fine accurate work, it is amply strong enough for rough and heavy work as well. The saw is 12 inches in diameter, and when raised projects three inches above the table. Saws up to 14 inches in diameter can be used. The ripping fence tilts to any angle up to 45 degrees. The floor space of the machine is 41 by 66 inches, the size of the table 31 by 38 inches, and the height 32 inches.

UNDER-BELTED DISK GRINDER: Gardner Machine Co., Beloit, Wis. The improvement in this grinder over the Gardner grinder illustrated and described in the July, 1908, issue of MACHINERY, consists mainly in the drive and a slight modification of the frame, so that the belt can be passed over the machine spindle pulley, down through the base of the machine, and through the floor to a motor mounted in the ceiling below or in the pedestal of the machine. The spindle pulley and belt are entirely enclosed so that the whole machine offers a compact substitute for the direct motor-driven disk grinder, which presents the difficulty that grinding dust is liable to get into the working parts of the motor.

DOUBLE CRANK PRESS: E. W. Bliss Co., 5 Adams St., Brooklyn, N. Y. This machine is adapted for heavy cold bending, drawing and forming operations in thick sheet steel manufacture. It is particularly intended for work of large dimensions, such as automobile engine crank cases, frame members, channels, etc., and for heavy cutting and perforating. The machine is capable of exerting a safe working pressure of 800 tons. The width between the frame columns is 74 inches, and between the gibs 67 inches. The stroke of the slide is 14 inches and the distance from the bed to the slide, the stroke down and the adjustment up, 20 inches. The adjustment of the slide is 6 inches.

HARDENING FURNACES FOR HIGH-SPEED STEEL TOOLS: American Gas Furnace Co., 24 John St., New York City. These furnaces are the results of a series of experiments undertaken to determine the best means for hardening different kinds of high-speed steel tools in gas blast furnaces. Different types of furnaces have been adopted for various kinds of tools, each type being, of course, used for a considerable variety. For instance, a special furnace is made for heating reamers, drills, taps and other tools of considerable length but small diameter. Small cylindrical work is suspended by the shanks in the heating space and is removed after heating without coming in contact with the lining of the furnace or the supports, thus preventing injury to the fine cutting edges.

ELECTRIC PYROMETER: Bristol Co., Waterbury, Conn. This pyrometer is intended for high temperatures and is designed to permit quick readings. An advantage of the instrument is that its construction substitutes an inexpensive metal for the expensive platinum-rhodium for the larger part of the couple. The tips of the couple, however, are of platinum-rhodium, and may be exposed to a temperature of 3,000 degrees F. without danger of the temperature at the junctions between the tips and the remainder of the couple exceeding a safe limit. The complete instrument is portable and temperatures up to 2,500 degrees F. can be obtained in a few seconds. By using a special form of tip, the instrument can be used for measuring the temperature of hot metal surfaces.

FORTY-TON DUPLEX CHAIN BLOCK: Yale & Towne Mfg. Co., 9 Murray St., New York City. This chain block has been brought out to meet the demands of the trade for a dependable hand hoist for handling very heavy loads in cases where the installation of an electric crane or steam hoist would be out of the question. It is composed of two 20-ton units with equalizing bars at top and bottom, thus providing for a single point of suspension and a single point of attachment of the load. Provision is made for swiveling each unit at top and bottom. The hand chains are arranged to permit two, four or eight men to work effectively. When the load is larger than 40 tons, it can generally be handled by two of these hoists working together, giving a double capacity of 80 tons.

MOTOR-DRIVEN SENSITIVE DRILL: Willey Machine Co., Jeffersonville, Ind. This drill press has been built heavier than former designs, and has a square table instead of a round one as previously used. The motor is connected to the spindle by a belt and cone pulley, and three changes of speed are provided. The motor is adjustably mounted for tightening the belt, and the starting switch is placed within the motor frame, eliminating connections outside of the motor. The distance from the center of spindle to the column is 12 inches, the maximum distance between the spindle and table 38 inches, the vertical motion of the spindle 3 inches, and the size of the table 11½ inches square. The total height of the drill is 67 inches, and the weight of the machine 200 pounds. It requires a 1/3 H. P. motor.

VERTICAL KEYSEAT MILLING MACHINE: Newton Machine Tool Works, Inc., 24th and Vine Sts., Philadelphia, Pa. This machine is adapted particularly for keyseating, and is built along the lines of a vertical milling machine. The spindle is mounted in a vertically adjustable saddle, so that a minimum distance of 6 inches and a maximum distance of 18 inches between the end of the spindle and the top of the table is obtainable. The spindle speeds vary from 142 to 395 revolutions per minute with the back-gears in, and from 430 to 1,194 revolutions per minute when driving direct with the back-gears thrown out. The work-table is 11 inches wide and 40 inches long, surrounded by an oil pan. It has an automatic power feed motion of 36 inches in either direction. The feed motion is obtained by a feed box giving nine changes. The machine occupies a floor space of about 4 by 5 feet.

THREE-HEAD REAMING AND TAPPING MACHINE: Niles-Bement-Pond Co., 111 Broadway, New York City. This machine is adapted for work on cast iron T- and L-shaped pieces up to

18 inches, and steel T's and L's up to 12 inches. It is provided with three heads mounted on a T-shaped bed, and has a stationary table to which the cradles for holding the work are clamped. Each of the three heads has independent hand adjustment and drive, as well as independent power feeds suitable for reaming and tapping, the feeds obtainable being 1/32, 1/16 and 1/8 inch per revolution. The maximum distance from the center of the machine to the ends of the spindles is 26½ inches; the distance the centers of the spindles are above the work-table is 15 inches. The spindle speeds are from 3¼ to 14 revolutions per minute. The power for each head consists of a 12½ H.P. variable speed motor.

INCLINABLE ROTARY FURNACE: Rockwell Furnace Co., 26 Cortlandt St., New York City. This furnace, intended for smooth round work, has a rotating cylinder or drum lined with a standard hard refractory brick with a smooth internal surface. The furnace is capable of being inclined, and the gradual incline causes the material to feed forward. The degree of pitch may be adjusted through a hand-wheel so as to regulate the progress of the material through the furnace to the required time of heating. This automatic continuous heating provides for a uniform heat in all the pieces, none of them being likely to be overheated or not sufficiently heated, as is the case in stationary furnaces. These furnaces can be built to suit different requirements, and in sizes to handle up to 2,000 pounds of stock per hour.

UNIVERSAL BORING TOOL-HOLDER: The Robinson Tool Works, Waterbury, Conn. This tool-holder differs from other holders intended for the same purpose particularly in that it passes over the lathe tool-post instead of passing through the tool-post slot. It is clamped by means of the regular tool-post wedge and screw, the tool supporting ring or washer being removed from the tool-post. The advantages claimed in connection with this tool-holder are that it elevates the boring tool horizontally, that tools of any diameter and of any kind of round stock can be used, and that it is always possible to have the tool projecting the right length from the holder. It is made in five sizes, the smallest size adapted to a No. 1 watchmaker's lathe, and the largest to lathes having 20 to 36 inches swing and taking boring bars to 1¼ inch in diameter.

VARIABLE SPEED COUNTER-SHAFT: Hawkeye Mfg. Co., Cedar Rapids, Ia. This device depends for the variations of speed on the greater or less amount of slipping in the frictional contact between the constant speed driving pulley and the shoes of a spider carrying the driven pulley. It is claimed that uniform speeds are obtained, due to the fact that the principle of the centrifugal governor is introduced in the mechanism. The essential parts of the device are driven pulley and a friction clutch of the drum and brakeshoe type, having an adjustable contact controlled by a lever, or a sheave with drop chain, with which the pressure of the shoes on the wheel face can be regulated. Not only the cone pulley, but also the tight and loose pulleys, are eliminated from the drive. A continuous range of speeds from the maximum to the minimum is obtainable.

SURFACE AND TOOL GRINDER: Robinson Tool Works, Waterbury, Conn. This grinder has been designed for grinding the faces of small dies and punches and for surface grinding of other small parts occurring in tool work. It can also be used as a regular tool grinder, and is provided with holders for grinding twist drills and milling cutters. It consists of a head carrying two wheels, one at each end. A table or platen is provided under one of the wheels. The other wheel is provided with an adjustable tool-rest and a fixture for holding twist drills, this latter having a capacity for drills from ¼ inch up to 1½ inch diameter. The machine is either adjustably mounted on a column or furnished as a bench grinder. The diameter of the surface grinding wheel is 5 inches and of the drill grinding wheel 6 inches. The net weight of the machine, including counter-shaft, is 180 pounds.

RIVET SPINNING MACHINES: Grant Mfg. & Machine Co., 80 Silliman Ave., Bridgeport, Conn. Three new riveting machines have been brought out by this company, two being riveters of the noiseless type equipped with flat and horn tables, and designed for work requiring a great depth of throat; work 11½ inches from the edge can be riveted. On the riveter provided with a flat table, fixtures can be mounted for different classes of work. The machine with the horn table is especially adapted for the manufacture of railroad lamps, signal lamps, metallic doors, etc. A small double spindle riveting machine for rivets ¼ inch in diameter and less and adapted for light work such as small hinges, jewelry novelties, etc., has also been brought out. It heads simultaneously both ends of a plain wire passing through the work. This machine may be mounted on a bench or pedestal and is operated by a treadle attached to the floor. The maximum capacity between the spindles is 1½ inch.

HIGH-SPEED DRILLING AND TAPPING MACHINE: Cincinnati-Bickford Tool Co., Cincinnati, O. This machine has been designed to meet the requirements of a high-speed and high-powered machine, particularly adapted for high-speed steel twist drills. It is also provided with a slow speed for tapping and with a quick return for withdrawing the tap. It is of the upright type, motor or belt driven as required, and provided with special bracing in the back of the column to provide additional strength. The head is vertically adjustable on the column; the spindle is provided with ball bearings, and jam nuts for adjustment, and an automatic stop so that a number of holes may be drilled to a given depth. A geared feed box is located on the sliding head and provides for six feeds varying from 0.006 to 0.039 inch per revolution of the spindle. The lever for manipulating the back gear when placed in a neutral position will stop the spindle. The machine is provided with gear box drive when belt driven, but in the variable speed motor driven machine the motor takes the place of the gear box. The gear box provides for 18 different speeds, giving, in connection with the back-gears, 36 spindle speeds varying from 38 to 534 revolutions per minute. The machine is provided with the company's patented geared tapping attachment, and a high-speed attachment, desirable for drilling small holes, may also be used in connection with this drill. The machine is built in sizes from 24 to 42 inches.

* * *

THE SALE OF THE IRON AGE

The sale of the *Iron Age*, the formal transfer of which was made the latter part of September, transfers to new owners the oldest and best-known trade publication in this country. The publication will be continued by the David Williams Company, with Charles T. Root, President, Charles Kirchhoff, Vice-President, and W. H. Taylor, Secretary and Treasurer.

In his valedictory, which is given the leading editorial place in the last number, Mr. Williams says:

The conductors of *The Iron Age* have always felt their responsibility as publishers of an organ of important information to which the trade looked for impartiality and fairness. Its reputation (even in other hands) is dear to us, and on no account would we have entertained a proposition to allow the paper to get into the hands of men whose ideals of journalism were not high. Fortunately this is not the case here. The purchasers are men of standing and eminently qualified for the task they have undertaken. I have known Mr. Root for many years, and entertain for him a profound respect and regard, not only as a peculiarly able publisher, but as a charming and high-minded man. His associates are publishers of character, experience and skill. I feel that *The Iron Age* is safe in their hands and wish them all possible prosperity and success.

The opinion Mr. Williams holds of the gentlemen who now control the *Iron Age* is shared by all who know them, and especially by trade paper publishers whose knowledge is more intimate and personal. Under their management the *Iron Age* will undoubtedly advance along new and aggressive lines, to even greater prosperity than it attained under its former owners.

* * *

WORCESTER TRADE SCHOOL

Plans for the proposed Worcester trade school have been prepared by the architects, and submitted for consideration. The academic building has a frontage on Grove St. of 200 feet and runs south on Concord St. to Prescott St. It is to be built of brick with limestone trimmings and the estimated cost is $275,000. Fronting on Grove St., is the academic section of the wing, 57 feet by 52 feet, three stories and basement. Attached to the academic section and fronting on Concord St. is the shop, 214 feet long and 42 feet wide, two stories and basement. The first and second floors of the academic section will be occupied as class rooms, and on the third floor is a large drafting room. The basement and first story of the shop section will be given up to the machine shop and the second floor will be devoted to the wood-working department. At the south end of the shop, fronting on Prescott St., will be the power plant in the basement and on the opposite side is the blacksmith shop. The moulding room will be on the first floor under these departments. A department for bookkeeping and cost accounting is provided for, where the pupils will be taught the cost of production. The wing about to be constructed will accommodate about 300 boys, and the estimated cost is from $50,000 to $60,000.

* * *

The central idea that the boy gets at college is training, training of the mind, storing the mind full of things. Now I say, without the slightest hesitation, that for success in life, intellectual training comes second or third. Without question, character comes first; good sense, second; and intellectual training, third.—*F. W. Taylor.*

THE VERNAZ CIRCULAR CUT FILE*

The Vernaz file has been previously illustrated and a general description presented in the March, 1907, and the September, 1908, issues of MACHINERY. In the latter of these issues it was referred to as the "Vixen" file, this name being the American trade name. The file is the result of an effort on the part of Mr. Alexis Vernaz of Yverdon, Switzerland, to save from the scrap heap a large number of accidentally hard castings. Proving itself successful, it was patented in nearly all industrial countries. The most prominent feature of the file, apparent to the casual observer, is that the teeth of the file are cut circular as shown in Fig. 1.

The essential feature of the Vernaz file, outside of the circular cut, is the form of the tooth itself, the section of the teeth being similar to that of the teeth in a milling cutter. The included angle of the teeth is 60 degrees, with a front rake of 1½ degree. The number of teeth per inch varies from 6 2/3 to 16, according to the purpose for which the file is intended. The teeth are cut one at a time with an end mill made in the shape of a hollow cylinder, having a diameter of from 2½ to 3 inches, and the edge beveled off to an angle of 60 degrees. This end mill is set at an angle of 1½ degree with a line at right angles to the plane of the file. In the manufacture of the files, automatic machines rotate the cutters, feed them into the file blanks to the proper depth, withdraw them, index or move the file the length of the pitch, and then repeat the same action for the next tooth.

At first it would seem that the inclination of the axis of the cutter would produce a cutting edge on the file which would not be flat, but concave. This, of course, is true of the bottom of the cut, but the shape of the top or edge, being produced by the intersection of the conical (beveled) face of the cutter with the cylindrical surface made by the preceding cut, is rather doubtful at first sight. In Fig. 2 the true shape of the edge has been determined by drawing it in a scale several times the true size. In this illustration lines *C* and *D* are corresponding elements of the cylindrical and conical surfaces of the tooth at the edge of the file, and determine the corner *A* of the tooth. The point *A* at the outer edge of the file falls distinctly below the surface of the blank. The top of the file, consequently, is very slightly convex, which is probably an advantage. The convexity is very slight, amounting to only about 0.002 inch on a file 1¼ inch wide.

It has been found that the circular cutting edges cut properly whether the file is pushed straight or at an angle, and also that the relatively large pitch and depth of teeth prevent clogging and the necessity of cleaning, and produce exceptionally smooth surfaces. The surface produced on steel is smoother than that from an ordinary second-cut file, due to the fact that the latter has a tendency to retain small chips between the teeth which scratch the surface filed. On fibrous and tenacious materials, such as wrought iron, mild steel, brass and aluminum, the improvement over ordinary files is very marked. That the action is a cutting one and not an abrading or grinding action, is shown by the chips, which under the magnifying glass are curled up and look as if they were made by a lathe or planer tool.

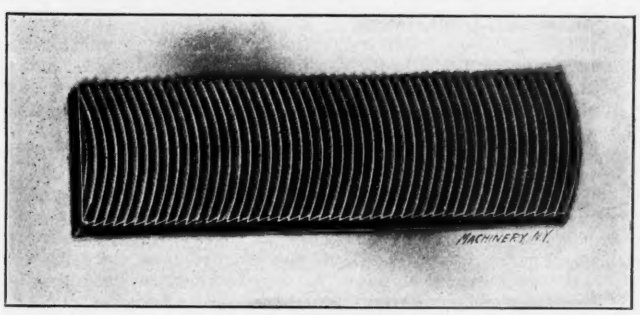


Fig. 1. A Section of the Vernaz File, known in the United States as the "Vixen" File

Tests have been undertaken on these files at the works of Wm. Sellers & Co., Inc., and by Tinius Olsen & Co., Philadelphia, Pa., using a file-testing machine built by Edward G. Herbert, Ltd., of Manchester, England. (This machine was described in the December, 1907, issue of MACHINERY, engineering edition, and also referred to in the September, 1909, issue of MACHINERY, engineering edition, in an article entitled "The Testing of Files and Tool Steel." In making comparative tests of twenty-nine files from eleven different makers, it was found that twenty-eight out of the twenty-nine regular commercial files, when tested on cast iron, removed from 0.7 to 20.6 cubic inches, while only one file removed 73 cubic inches. These tests also bore out the results of experiments made by Edward G. Herbert himself, showing that the two sides of a file often show extreme variation in cutting capacity. In the tests referred to, the worst case of this kind was a file which removed 20.6 cubic inches by one side and 0.4 cubic inch by the other. Four Vernaz files have been tested on cast iron. The poorest one removed a total of 48.2 cubic inches, using both sides, and the best 143.75 cubic inches, the variations between the two sides being very slight, the worst case being a file removing 49.1 cubic inches by the one side and 34.9 by the other. On high carbon steel the minimum and maximum figures for ordinary commercial files were 3.6 and 6.4 cubic inches, and for the Vernaz files 9 and 25.8 cubic inches. In this case, however, two out of three Vernaz files showed a marked difference on the two sides.

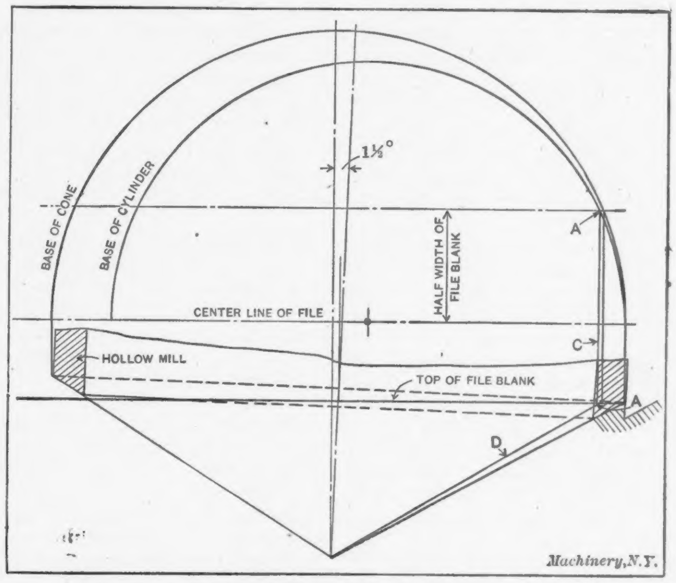


Fig. 2. Diagram used for showing that the Top Surface of the Vernaz File is Convex

The committee of the Franklin Institute reporting on the Vernaz file considers that this invention is the first radical improvement in files for generations, and that the inventor has done the industrial world a marked service, not only in presenting a new and efficient cutting tool for metals, but also in the impetus which the introduction of the tool will give to improvement in cutting capacity and endurance of the regular type of files. The committee, therefore, recommended that the inventor be awarded the Elliott Cresson medal as an appreciation of his achievement.

* * *

Santos-Dumont, the Brazilian aviator who attracted the attention of the world to himself some years ago by his dirigible balloon experiments and exploits, lately built an aeroplane of diminutive size that flew at a speed of fifty-five miles an hour near Paris, September 14. It weighs together with pilot only 260 pounds, and has only nine square yards of wing surface as against twenty-two square yards in the Curtiss aeroplane, twenty-six square yards in the Bleriot machine and fifty-three square yards in the Wright machine. The motor is a two-cylinder gas engine developing 30 horsepower at 1,800 R. P. M. The machine, which is of the butterfly type, is so constructed that it can be used both as an aeroplane and a motor car, rising at will from the road, and descending again to run on the ground. Santos-Dumont expects to reduce the distance required to rise to about forty or fifty yards. The trials at St. Cyr required only seventy to eighty yards to start.

* Abstract of a report of the Franklin Institute, through its Committee on Science and the Arts, published in the *Journal of the Franklin Institute*, September, 1909.

PERSONAL

Charles S. McCarthy has taken the position of superintendent with the Warner Mfg. Co., Toledo, O.

O. J. Sundstrand has been elected secretary and treasurer of the newly-organized National Machine & Tool Works, Rockford, Ill.

William M. Grove has been given full charge of the Cleveland territory for the product of the Ingersoll Milling Machine Co., Rockford, Ill.

T. F. Meek, for twenty-one years with the Detroit Steel Casting Co., is now vice-president and general manager of the Toledo Steel Casting Co., Toledo, O.

C. C. Wais of the C. C. Wais Machine Co., Cincinnati, Ohio, has sold his business, and is now connected with the Covington Machine Co., Covington, Va.

F. G. Kernan, formerly Eastern sales agent for the Fox Machine Co., Grand Rapids, Mich., has been made general sales manager of the company, with headquarters at Grand Rapids.

M. T. Lanse has been made secretary and treasurer of the Foglesong Machine Co., Dayton, Ohio, succeeding A. C. Jackson, who is now cashier of the North Dayton Savings Bank.

Henry Bowman, formerly with the Detroit Steel Casting Company, has taken the position of superintendent of the Toledo Steel Casting Co., which firm succeeds the C. E. Sutton Company.

Perley E. Harvey, who recently resigned from the position of assistant superintendent at the Chapman Valve Mfg. Co., Springfield, Mass., has taken a position with the Fore River Ship Building Co., Quincy, Mass.

W. S. Chase, sales manager of the National-Acme Mfg. Co., Cleveland, Ohio, sailed September 11 for a two months' business trip in Great Britain and on the Continent. He was accompanied by his wife.

Frank Salomon, representative of the engineering staff of Alfred Schütte, Cologne, Germany, is on a visit to America in the interests of his house. His American address is Alfred H. Schütte, 90 West St., New York.

The name of the heating and ventilating engineer of New York, referred to in the article by Mr. C. M. Ripley, "Pure Air Law for Workmen" in the September number, engineering edition, is Percival Robert Moses.

Edwin Cedarleaf, formerly superintendent of the Rockford Machine & Shuttle Co., is now general manager of the National Machine & Tool Works, a concern which succeeds to the old Dalin Bros.' shop and business in Rockford, Ill.

Adolph W. Gilbert has been elected president and general manager of the Chapman Valve Mfg. Co., Springfield, Mass. Mr. Gilbert recently resigned from the position of general manager with the Pratt & Cady Co., Hartford, Conn.

Charles M. Robertson, superintendent of the Colburn Machine Tool Co., Franklin, Pa., resigned his position September 1 to become a salesman with the E. L. Essley Machinery Co., of Chicago and Milwaukee, agent for the Colburn boring mill.

T. W. Warner has been elected president and general manager, and E. S. Janney, secretary-treasurer of the newly organized Warner Mfg. Co., maker of automobile gears and transmissions, which occupies a part of the old Pope plant in Toledo, Ohio.

Frank H. Hill, formerly in the sales and engineering departments of the New York office of the Sprague Electric Co., has been made manager of the Atlanta, Ga., branch office, and assumed his new duties September 1. Mr. Hill succeeds Mr. F. V. L. Smith, resigned.

P. P. H. Conover, secretary and treasurer of the Miami Valley Machine Tool Co., Dayton, Ohio, returned in September from a two months' trip in Europe. He visited England, France, Germany, Italy and Switzerland. The trip was partly on business and partly for pleasure.

P. T. Wingo, for twenty-two years with the Brown & Sharpe Mfg. Co., Providence, R. I., on work relating to gearing and special machinery, has resigned and is now connected with the Cadillac Motor Car Co., Detroit, Mich., in a general mechanical engineering capacity.

A. W. Lewin was advanced September 1 to the position of manager of the New Orleans office of the Sprague Electric Co., New York. Mr. Lewin is a member of the American Institute of Electrical Engineers, and has had extensive commercial and engineering experience in the electrical business in both North and South America.

James H. Norris, for the past nine years business manager of the John F. Allen Riveting Machine Co., 370-372 Gerard Avenue, New York City, resigned his position, his resignation having taken effect September 1. It was Mr. Norris' intention to take a rest of about two months, part of which time was to be spent on an extended trip.

P. J. Hoenschied, for several years vice-president and mechanical manager of the National Twist Drill & Tool Co., Detroit, Mich., has disposed of his interests in that concern and expects to start a new company for the manufacture of automobile parts. The Hoenschied stock was purchased by members of the National Twist Drill & Tool Co.

C. E. Wust, of C. E. Wust & Co., Seebach, Zurich, Switzerland, is in America to establish licensees for making the Wust herringbone gearing (see MACHINERY, engineering edition, April, 1908, page 515) and to make a contract with some maker of American machine tools to build the Wust herringbone gear-cutting machine. The Grand Union Hotel, New York, is his headquarters.

M. M. Shepherd has just been appointed shop instructor at the James Millikin University, Decatur, Illinois. Mr. Shepherd has had wide experience both as a mechanic and as an instructor in designing, drafting, pattern-making, forging, foundry and shop work. He was for three years teacher of manual training in the city schools of Providence, R. I., and four years in similar work in the high schools of Milwaukee, Wis.

F. H. Banbury, engineer of the Acheson-Oildag Co., Niagara Falls, N. Y., sailed for Europe on the steamship *St. Louis*, September 25. Mr. Banbury is an Englishman by birth; he came to America about five years ago and became connected with the Acheson-Oildag Co. over a year ago. His European trip is taken in the interest of the company to introduce deflocculated graphite, the discovery of Edward G. Acheson, president of the company.

W. E. Wickenden has been appointed assistant professor of electrical engineering of the Massachusetts Institute of Technology, Boston, Mass., and will assume the duties vacated by Prof. G. E. Shaad, who has gone to the University of Kansas to take charge of the electrical engineering department there. Mr. Wickenden is a graduate of Dennison University, and is a member of the electrical engineering staff of the University of Wisconsin. He is the author of a book on photometry and illumination.

* * *

OBITUARIES

James Denver, formerly master car builder of the N. Y., N. H. & H. R. R., died August 19, and was buried in Springfield, Mass.

Walter E. Andrews, president of the Williams Typewriter Co., died at his home in Shelton, Conn., September 7 of arterial trouble, aged fifty-nine years. Mr. Andrews was a native of Vermont, and, when a young man, went West and resided in Des Moines, Iowa, for many years, where he became president of the Western Newspaper Union. He came East to Brooklyn and about nine years ago removed to Shelton.

Russell Markham died at the home of his son, E. R. Markham, Cambridge, Mass., August 24. Mr. Markham, during war times, worked on rifles for the United States government at the old Jones & Lamson shop, Windsor, Vt., and the Massachusetts Arms Co., Chicopee Falls, Mass. After the close of the civil war the Lamb Knitting Machine Co. bought the Massachusetts Arms Co. plant and Mr. Markham entered its employ as foreman, which position he held for nearly forty years, retiring only four years ago on account of advanced age.

Robert Hoe, 3rd, head of R. Hoe & Co., printing press builders, New York and London, died in London, September 22, aged seventy years. Mr. Hoe was the third in line of printing press builders. His grandfather, Robert Hoe, came to America from Leicestershire, England, in 1784, and in 1803 started a printing press plant with his brothers-in-law, Mathew and Peter Smith. Mr. Hoe was succeeded by his two sons, Col. Richard M. Hoe and Robert Hoe, 2nd. Robert Hoe, 3rd, was a son of the latter, and succeeded to the management in 1884. At the time that Robert Hoe, 3rd, entered the business, the cylinder press invented by his uncle, Richard M. Hoe, had a capacity of only 9,000 sheets of four pages each per hour, which had afterwards to be folded by separate machinery or by hand. Hoe presses are now built that are fed with eight rolls of paper at once, and produce 166,000 16-page newspapers per hour, folded ready for delivery. While Mr. Hoe was remarkable for his inventive capability, it is said he never took out a patent in his own name. He was an organizer of ability and systematized his factory thoroughly in all departments. Mr. Hoe also had some reputation as an author, having written several books on book-binding, evolution of printing presses, etc. He gave a great deal of attention to the education of apprentices, and every boy apprentice to R. Hoe & Co. was compelled to attend school, one hour of his working time and one hour of his own time being devoted to this purpose every week day evening. The Grand Street factory, New York, employs about 2,500 men, and the London factory about 800 men.

* * *

The Zeppelin airship has found a serious rival in the Schütte airship, which will undergo thorough trials within a few months. This navigable balloon will have a lifting capacity of five tons, and its chief interest centers in the fact that the inventor has devised means for storing the gas forced out of the balloon by the ascent into high altitudes, or by the expansion due to the heat of the sun's rays. This fact

will enormously extend the possibilities of remaining in the air, as the gas can again be supplied to the balloon as required. The plans have been submitted to leading aeronautic experts and are said to have met with their encouragement. Prof. Schütte retains the rigid frame of the Zeppelin airship but employs wood instead of aluminum, and the cover has a lining of gold-beater's skin. From these new features important advantages are anticipated. The airship will be lighter and more elastic, the loss of gas will be reduced to a minimum, and the absence of metal in the framework will render ignition from lightning less probable. At the same time, the absence of metal enables a wireless telegraphy outfit to be carried in the car without danger.

* * *

COMING EVENTS

October 3-9.—St. Louis Centennial Week, St. Louis, Mo. Balloon, airship and aeroplane races will be arranged under the auspices of the Aero Club of St. Louis.

October 4-8.—Annual joint convention of the American Street and Interurban Railway Association, American Street and Interurban Railway Accountants' Association, American Street and Interurban Railway Engineering Association, American Street and Interurban Railway Claim Agents' Association, American Street and Interurban Railway Transportation and Traffic Association, American Street and Interurban Railway Manufacturers' Association, at Denver, Col. Bernard V. Swenson, secretary and treasurer, 29 West 39th St., New York.

October 12.—Monthly evening meeting American Society of Mechanical Engineers at the Engineering Societies Building 29 West 39th St., New York. Calvin W. Rice, secretary, 29 West 39th St., New York.

October 12-13.—Semi-annual convention of the National Machine Tool Builders' Association at the Hotel Astor, New York. P. E. Montanus, secretary, Springfield, Ohio.

October 14.—MACHINERY's seventh annual outing.

October 19-21.—Annual convention of the American Railway Bridge and Building Association, Jacksonville, Fla. S. F. Patterson, secretary, Boston & Maine R. R., Concord N. H.

April 1-June 30, 1910.—American Exposition in Berlin to stimulate trade relations with Germany and American export business generally. The exposition will be held in the Exposition Palace, having 110,000 square feet floor space. Max Viewger, American manager, 50 Church St., New York.

December 1-13.—Annual convention of National Association for the Promotion of Industrial Education, Milwaukee, Wis. J. C. Monagham, secretary, 20 West 44th St., New York.

NEW BOOKS AND PAMPHLETS

INVENTIONS, PATENTS AND DESIGNS. By G. Croyden Marks. 116 pages, 4¾ by 7 inches. D. Van Nostrand Co., New York. Price $1.

This work contains the full text of the British patent and designs act of 1907 and will for this reason be particularly valuable to Americans who are interested in British patents. The general text treats of fostering industries, the meaning of patents, what is patentable, surrender and revocation of patents, licensing of inventions, infringement of patents, patent working in America, legal proceedings, applying for an injunction, how to work patents, designs, etc.

POCKET MANUAL OF ENGINEER'S SOLAR TRANSIT. 53 pages, 4½ by 6½ inches, 9 illustrations. Published by Keuffel & Esser Co., 127 Fulton St., New York, and Hoboken, N. J.

The manual describes the Keuffel & Esser engineer's solar transit, its adjustments and method of use. A table of mean refractions is included, also rules for taking the sun at any latitude or longitude, determining the meridian by direct observation on the sun and determining the meridian by observation on Polaris. While the manual is designed for engineers and others fully familiar with the use of the transit, it will also be found of considerable interest to amateurs and others who would like to know how the polar explorers Cook and Peary located the pole or how navigators verify their position in mid-ocean.

MACHINE SHOP DRAWING. By Fred H. Colvin. 139 pages, 4¼ by 6¾ inches, 91 illustrations. Published by the McGraw-Hill Book Co., New York. Price, $1 net.

This book is intended to help those who do not understand the reading of drawings rather than to teach drawing itself. It is a fact that many good mechanics are "shy" on reading blue-prints, and this treatment of the subject has been with a view of explaining to this class the principles of mechanical drawing, illustrating the same with examples of common objects found in machine shop practice. The contents by chapters are: Reading Drawings, Drawing of a Monkey Wrench, Some Examples of Drawings, Laying Out Spur Gears, Laying Out Bevel Gears, The Worm and Worm-wheel, and Sketching.

HENDRICKS COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. 1,220 pages, 7½ by 10 inches. Published by S. E. Hendricks & Co., 74 Lafayette St., New York. Price $10, express charges prepaid.

This well-known directory of the architectural, mechanical, engineering, electrical, construction, railroad, iron, steel, mining, mill, quarrying, exporting and kindred industries has passed into the eighteenth edition. It contains over 350,000 names and addresses and has 35,774 classifications, fully listing manufacturers and dealers in the industries mentioned. The comprehensiveness of the directory may be inferred from the statement made by the publishers that it lists for railroads everything from a track bolt to a locomotive; for mining, everything from a miner's lamp to a stamp mill of steel tipple; for the machine shop, everything from a tool-holder to a boring and turning mill or traveling crane; for foundries, everything from a molder's flask to a cupola; for contractors, everything from a pick or shovel to a hoisting engine or steam shovel; for the drafting room, everything from a drawing pencil to a blue-printing machine; for power transmission, everything from a belt fastener to a complete system including the latest specialties in right angle transmission and variable speed countershafts. The directory is one that we heartily recommend to all who desire comprehensive lists of concerns in the various industries. The lists are conveniently arranged for circularization, etc.

CATALOGUES AND CIRCULARS

FREDERICK O. DRAKE & Co., Fisher Building, Chicago, Ill. Catalogue of mechanical books for home study.

MODERN TOOL Co., Erie, Pa. Leaflet of universal grinding machines made in two sizes, 9 x 26 inches and 13 x 32 inches capacity, respectively.

AMERICAN RAILWAY STEEL TIE Co., Harrisburg, Pa. Circular describing the composite steel and asphalt filling tie made under the John G. Snyder patents.

PHILLIPS PRESSED STEEL PULLEY WORKS, 4th St. and Glenwood Ave., Philadelphia, Pa. Leaflet illustrating the Elliott Cresson medal awarded to Ferdinand Phillips, October 2, 1907, for his machinery for manufacturing pressed steel pulleys.

WELLS BROS. Co., Greenfield, Mass. Circular of machine screw taps and dies of the American Society of Mechanical Engineers standard. The A. S. M. E. sizes are being adopted by many manufacturers, and it is probably only a matter of a few years when the V-thread machine screws will become obsolete.

FRANK MOSSBERG Co., Attleboro, Mass. Five full size illustrations of Mossberg screw wrenches, namely: Midget, Sterling No. 2, Sterling No. 3, Sterling No. 14, and Sterling No. 50. The half-tones reproduce the beautiful mottled effect of case-hardening and are very attractive examples of half-tone illustrations.

ELECTRICAL ALLOY Co., Morristown, N. J. Catalogue No. 2 of resistance materials in every variety of wire, sheet and ribbon, nickel steel alloy, nickel copper alloy, ferro-nickel alloy, nickel-chromium alloy, German silver alloy, for use in the manufacture of arc lamps, resistance controllers, car heaters, measuring instruments, rheostats, etc.

CLEVELAND TWIST DRILL Co., Cleveland, Ohio. Leaflet on drill grinding, reproducing MACHINERY's shop operation sheets Nos. 100 and 101 on grinding flat and twist drills. The company supplies a model drill point in die-cast metal which is intended to serve as a guide to the proper grinding of drills. This will be found valuable by all users of twist drills. The price is $1.

NEW ERA GAS ENGINE Co., Dayton, Ohio. Catalogue of New Era auto-cycle which is designated as a two-wheeled automobile, and is operated similarly to an automobile. It has no pedals and is driven by an air-cooled 3½ horse-power single-cylinder motor through a two-speed gear that enables the rider to ascend the steepest hills found on the ordinary highways.

KEUFFEL & ESSER Co., 127 Fulton St., New York, and Hoboken, N. J. Price list of blue-print papers which are supplied in three grades as regards time: regular, requiring from four to eight minutes' exposure in bright sunlight; quick, for work required on short notice and where no good light is available, and electric quick, for use with electric light and electric printing machines.

WESTERN ELECTRIC Co., 463 West St., New York. Bulletin of tungsten miniature low voltage incandescent lamps, 1.5 to 20 volts. These lamps vary in efficiency from 0.9 watt per candle power to 1.33 watts per candle power, and are desirable for use on automobiles, flash-lights, signs, dental, optical and surgical instruments, etc., and in fact in any place where small low-voltage power lamps are used.

MIAMI VALLEY MACHINE TOOL Co., Dayton, Ohio. Catalogue F of Miami Valley engine lathes made in 13-inch and 16-inch sizes, 13-inch stud lathes, sensitive drills, plain cutter and reamer grinders, No. 2 universal grinder with automatic feed, No. 2 universal surface grinder, No. 1 universal cutter and tool grinder. The operations of grinding a form cutter, gear cutter, blanking punch, spiral cutter, T-slot cutter, side milling cutter, etc., are illustrated.

INGERSOLL-RAND Co., 11 Broadway, New York. Bulletin No. 4009 of Temple Ingersoll "electric air" rock drills. The Temple Ingersoll "electric air" rock drill apparatus comprises an electric motor and a two-cylinder air pump and the rock drill proper. The air pump is connected with the rock drill by two hose and the pulsations of the pump work the drill in unison, using the same air continuously.

CHAPMAN ENGINEERING Co., 917 Land Title Building, Philadelphia, Pa. Catalogue of casehardened, corrugated copper flange gaskets, adapted to all kinds of steam service, working equally efficiently under superheated steam, high pressures or low pressures. These gaskets are guaranteed not to burn or blow out, to stand 500 pounds steam pressure and superheated steam of any practicable working temperature and to make an absolutely tight joint on a rough or pitted surface.

NORTON Co., Worcester, Mass. Booklet entitled "Facts Worth Knowing about Grinding Wheels," containing valuable information for users. The Norton grinding wheels are made by three processes—vitrified, silicate or semi-vitrified, and elastic, and in grades suitable to all classes of work. Suggestions for ordering are given which will be found valuable by those who are not fully aware of all the factors that enter into the selection of grinding wheels necessary to secure the highest efficiency.

NEWMAN-ANDREW Co., 107 West St., New York. Circular of "Toledo" high-speed steel manufactured by Jno. Hy. Andrew, Ltd., Toledo Steel Works, Sheffield, England. The circular gives directions for treating "Toledo" high-speed steel, ordering steel suitable for various purposes, such as cold chisels, boiler snaps, mint dies, rock drills, lathe tools, milling cutters, etc., and lists the various brands manufactured. A comparison of thermometric scales, and tables of weights of bar stock per lineal foot are appropriately included.

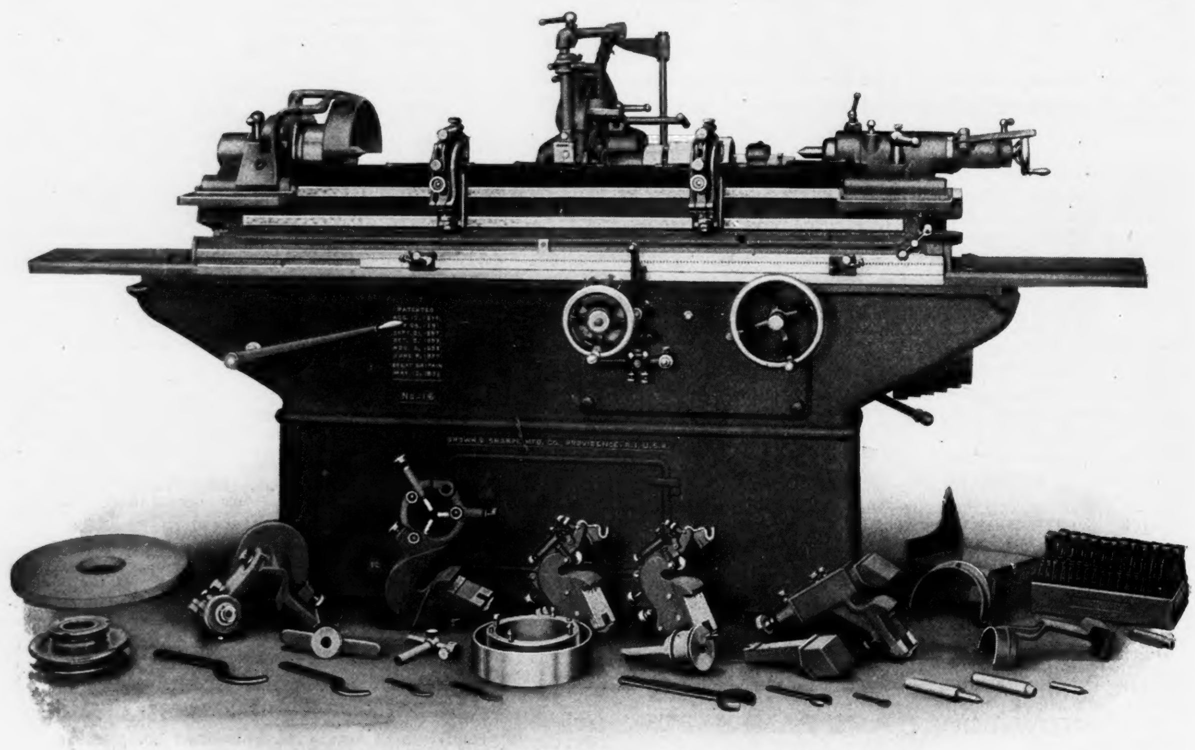
ELECTRO-DYNAMIC Co., Bayonne, N. J. Circulars No. 29, 32, 34 and 35, illustrating the electro-dynamic interpole variable speed motors which have the following characteristics: 1. Constant speed at any controller position regardless of load. 2. Wide speed range by field control. 3. Freedom from sparking. 4. Compactness. 5. Reversibility. 6. Operation on any single voltage—110, 210, or 500 volts. The circulars describe the theory of magnetic action and illustrate the construction of the motors, and their application to machine tools, elevators, printing presses, crane trolleys, vacuum cleaning pumps, centrifugal pumps, etc.

W. S. ROCKWELL Co., 50 Church St., New York. Circular of Rockwell annealing and hardening furnaces, giving dimensions, fuel consumption of oil and gas, and other data required by purchasers. The furnaces are made in 13 sizes, the smallest having chamber dimensions of 10 by 13½ inches, and entrance to chamber, 9 by 5 inches. The largest furnace listed has a chamber 39 by 54 inches with entrance 36 by 18 inches. These furnaces are suitable for annealing, hardening, tempering and casehardening, but are not adapted for hardening high-speed steel.

NATIONAL FILE & TOOL Co., 2110 Allegheny Ave., Philadelphia, Pa. Catalogue of the "Vixen" patent hand milling tool. The Vixen file and milling tool was described in the May, 1909, number of MACHINERY. It differs from the ordinary file in the shape of the cut, the teeth being formed on the arc of a circle and so shaped as to give a smooth shearing action. It is claimed that the Vixen file and milling tools will cut from three to five times as fast as an ordinary file tool, and last from four to six times as long. They are particularly efficient on soft metals and alloys such as babbitt, lead, aluminum, etc., cutting rapidly and being self-cleaning.

W. F. & JOHN BARNES Co., 231 Ruby St., Rockford, Ill. Catalogue No. 69 of upright drills and other machine tools, comprising bench friction disk drill, floor friction disk drill and regular upright drills of various patterns and designs from 15 inches swing to 50 inches swing, inclusive. These drills are provided with special attachments according to requirements, including gear tapping attachment, compound table, oil feeding device, multiple spindle head, etc. The Barnes horizontal radial drill is illustrated, and also the Barnes water emery grinder, adjustable screw press, universal sliding chuck attachment, and various features of design and construction of the upright drills.

BROWN & SHARPE MFG. CO.,



B. & S. Grinding Machine Accuracy is Permanent

When a machine is new its perfect working condition and ability to produce accurate work are naturally expected. **The real test, however, is that of long continued service** and it is here that is manifested the **excellent design** and **high quality** of **workmanship** which characterize

B. & S. Grinding Machines.

In construction a sufficient amount of metal is correctly distributed in all parts to secure rigidity—a factor of utmost importance. The working parts are easily accessible and all levers and hand wheels are conveniently located so that the operator may have full control from the front of the machine. This, together with the employment of a special cross feeding mechanism that causes work to be ground automatically to within .00025 of an inch of a required size, enables **one operator** to **easily run two machines.**

Another feature of great importance consists in the fact that the work speeds and table feeds are completely separated, permitting the correct table feed for any work speed to be obtained.

vises, drop-forged wrenches in a great variety of forms, socket wrenches, drop-forged steel snap gages, thumb screws, weldless eye bolts, automobile steering connections, drop-forged rod and yoke ends, automobile forgings, drop hammers, etc.

MANUFACTURERS' NOTES.

SIMONDS MFG. CO., Fitchburg, Mass., was awarded the grand prize at the Alaska-Yukon-Pacific Exposition, Seattle, Wash., for its exhibit of Simonds saws.

HILL-CLARKE & CO., Chicago, Ill., announces that on account of renumbering of the business places in the city its address will be changed from 14 South Canal St. to 125 North Canal St.

WESTERN ELECTRIC CO., 463 West St., New York, announces that it is now in a position to furnish "Sunbeam" tungsten lamps between 200 and 250 volts, and in four sizes: 45, 70, 112 and 180 watts.

CLEVELAND STEEL TOOL CO., Cleveland, Ohio, has instituted a suit for infringement of patent on its rolled head punches and split sleeves against the Cleveland Punch & Shear Works, and W. D. Sayle of Cleveland, Ohio.

WARNER & SWASEY CO., Cleveland, Ohio, builder of machine tools and manufacturer of optical instruments, will establish a Chicago

TRENTON IRON CO., Trenton, N. J. Treatise on the Bleichert system of aerial tramways by W. Hewitt. Various installations of aerial tramways were illustrated and the construction of the lock coil track cable made by the Trenton Iron Co. is shown. A folder illustrates the installation at the Laurentide Pulp Co., Montreal, Canada; Smuggler Union Mine, Creede, Col.; Iowa Gold Mining & Milling Co., Silverton, Col.; United Concentration Co., Monte Cristo, Wash.; Bachelor Commodore Mining Co., Creede, Col. The pamphlet will be found of much general interest to all concerned with the problem of cheaply transporting materials in a rough country across valleys, rivers and other obstacles.

S. OBERMAYER CO., Cincinnati, Ohio, publishes a house organ known as the *Obermayer Bulletin*, which is devoted to foundry practice and matters pertaining to successful foundry management. In the September number a series of articles on foundry troubles by Mr. R. H. McDowell was begun, which promises to be of much practical value to the foundry trade. Mr. McDowell addresses himself to foundrymen who have trouble from dead, dirty and hard iron, large breakages and heavy losses in general. He discusses cupola melting, what is the cause of slow and hanging charges when the bottom is dropped, etc. The copies of the *Bulletin* containing these articles will be sent free to applicants who are interested in foundry practice.

GUSTAV WAGNER, Reutlingen, Würtemburg, Germany. Catalogue (in English) of Wagner cold sawing machines, automatic saw sharpening machines, rotary planing machines and vertical milling machines. The cold sawing machines are made in a great variety of styles and sizes adapted to a wide range of work. The saw is mounted on the end of a horizontal member and is adjustable around its support so that the saw can be presented against the work at any angle in the vertical plane. The saw thus can be used either vertically, horizontally or at any intermediate angle. One style is made with a circular table which enables a number of cuts to be taken on the same plate without resetting. This style is adapted for making cuts in locomotive drivers and similar work.

ADAMS CO., 360 White St., Dubuque, Iowa. Catalogue of the Adams-Farwell aeronautic motor, which was described in the July, 1908, number of MACHINERY. The motor is of the revolving cylinder type, having five cylinders mounted radially and revolving around a stationary crank-shaft. This arrangement of the cylinders makes unnecessary a cooling fan, radiator, fly-wheel, muffler, and other parts necessary on the ordinary stationary cylinder type. The five-cylinder motor with cylinders 4 3/16 inches bore and 3½ inches stroke, weighs 97 pounds, and is rated at 35 horse-power by the A. L. A. M. formula $\frac{D^2 \times N}{2.5}$. The engine "spins like a top" having a diameter of 27 inches and a height of 16 inches. The normal speed is 1,000 R.P.M., and maximum, 1,500 R.P.M. Price, $1,200.

COATES CLIPPER MFG. CO., Worcester, Mass. Catalogue No. 22 of the Coates flexible transmission apparatus, comprising flexible shafts, breast drills, drilling heads with radial arms, drilling heads with chain supports, magnetic holders for drills, portable buffing apparatus, etc. The catalogue also lists electric motor-driven drills and grinders having flexible shaft transmission. This apparatus is used for drilling, grinding, buffing, polishing, etc. The catalogue illustrates auxiliary apparatus used with the equipment, including radial arms, mongrel gear drive, speed multiplier attachment, grinding heads, silversmiths' outfits, mounted carborundum points, special carborundum wheels, lathe grinders, plain surface grinders, sander cones, screw polishing outfits, window washers, horse clippers, motor-driven erasers for the drawing room (see MACHINERY, January, 1909), electric hammers, electric massage machines, etc.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J. Handsome illustrated hanger having for a centerpiece a realistic foundry scene. Brawny bare-armed men are shown in the red glow of the molding room pouring molten metal from a Dixon crucible into the mold. The illustration is made from a photograph and is true to life. At the top of the hanger is an illustration in black and white of the Joseph Dixon Crucible Co.'s plant in Jersey City. This great factory and offices cover nearly eighty city plots. Other illustrations on the hanger show Dixon products made especially for foundry and metallurgical purposes, consisting of crucibles, stirrers, boxes and covers used in burning electric wire filaments and for casehardening purposes, mufflers, brazing crucibles, dipping cups, skimmers, etc. Some valuable hints are also given on the care and use of graphite crucibles. The hanger is sent free to anyone interested.

THE UNITED STATES ELECTRICAL TOOL CO., Cincinnati, Ohio. Catalogue F-1909 of the United States portable electrical tools, comprising hand and breast drills for drilling from 0 to ½ inch diameter; portable electrically driven drills for use with an "old man" or radial arm, having capacity up to 1¼ inch diameter; tool-post grinders made in a variety of sizes for use in engine lathes, boring mills, planers, etc., for producing ground circular and flat work. The company also makes a specialty of an attachment for grinding milling cutters which can be applied to the table of any milling machine, for sharpening cutters in position. This practice is desirable where very smooth work is required, as it is generally found impossible to remove the cutter from the arbor, grind and replace it so that all the teeth will cut exactly alike. When ground in position, a perfect division of work among all the cutter teeth is insured. The catalogue is sent on request to all interested.

BILLINGS & SPENCER CO., Hartford, Conn. Catalogue with discount sheet of machine tools and drop forgings of every description in steel, iron, copper, bronze, etc. The tools listed comprise Billings & Spencer wrench, adjustable automobile wrench, adjustable S-nut wrench, adjustable S-pipe wrench, adjustable spanner wrench, bicycle wrench, tap and reamer wrench, improved combination pliers, combined wire cutters and pliers, improved wire cutter, all-steel screw driver, magazine screw driver, gun- and machine-makers' screw drivers, belt awl, drop-forged plain riveting hammer, drop-forged machine hammer, ratchet drills, taper drill sockets, flat drills and counter-sinks, drop-forged lathe dogs, machine clamps, drop-forged steel C-clamps, planer tool-holders, lathe tool-holders, cutting-off tools, knurling tools, hand

branch, and has bought a three-story manufacturing block at 97-99 West Washington St., for that purpose.

COLBURN MACHINE TOOL CO., Franklin, Pa., announces that its former superintendent and boring mill expert, Mr. C. M. Robertson, is associated with the E. L. Essley Machinery Co., Chicago and Milwaukee, acting as salesman of the Colburn boring mills.

REMINGTON TYPEWRITER CO., 325 Broadway, New York, has found it necessary to enlarge the capacity of its Ilion, N. Y., factory to take care of increased business. Orders have been placed for an additional power unit and for machine tool equipment amounting to about $50,000.

S. OBERMAYER CO. reports that the fire in its Cincinnati plant, Saturday night, September 11, merely damaged its warehouse and did no damage to the manufacturing departments. There will be no interruption of its business, and orders will be filled with the same promptness as heretofore.

L. H. GILMER & CO., Philadelphia, Pa., have been compelled to move to larger quarters because of their rapidly growing business. The business has been removed from 504 Arch St. to 52 North Seventh St., where a large, commodious building with improved special machinery has been provided, for turning out the Gilmer endless belts.

CINCINNATI PULLEY MACHINERY CO., manufacturer of pulley lathes, riveting machines and ball-bearing drill presses, has removed from 218 Second St., Cincinnati, Ohio, to 16th St. and Licking River, Covington, Ky., where it has about four times its former floor space, and much better facilities for taking care of its rapidly increasing business.

WESTERN ELECTRIC CO., 463 West St., New York, is reported in the *Wall St. Journal* as doing a gross business of $47,000,000 per annum. The business for August showed a gain of 5 per cent over July and 60 per cent more than for August, 1908. Sales have been especially good during the past year in cables, electrical machinery and general electric light supplies.

WESTINGHOUSE MACHINE CO., Pittsburg, Pa., recently installed four Westinghouse vertical 13- by 12-inch gas engines in the Hoboken and Passaic plants of the Public Service Corporation of New Jersey for boosting the gas pressure in gas pipe lines. These engines operate direct connected to Root blowers, delivering gas at a pressure varying from ¾ pound to 4 pounds per square inch.

CURTIS & CURTIS CO., 8 Garden St., Bridgeport, Conn., maker of Forbes patent die stock, reports a decided improvement in business. It is running its plant at full capacity in all departments, and recently sold two of its largest machines having a range from 4- to 15-inch pipe to the Davis Coal & Coke Co., Thomas, West Va., and the Atlantic City Electric Light Co., Atlantic City, N. J.

FRANK B. GILBRETH, 60 Broad St., New York, has been awarded the contract for the construction of a brick and reinforced concrete publishing building at Plainfield, N. J., for the Engineering News Publishing Co., New York. The structure will be erected from plans by Mr. Frederick A. Waldron, 37 Wall St., New York, who has been retained as architect and industrial engineer in charge of the mechanical layout.

WARREN WEBSTER & CO., Trenton, N. J., was defeated in its suit against C. A. Dunham Co. for infringement of the Webster patents on vacuum heating apparatus. The suit was brought against C. A. Dunham Co., Marshalltown, Iowa, manufacturer of the Dunham radiator traps. The court held that there was no patentable novelty in the Webster apparatus, and it simply comprised an aggregation of old devices shown in prior patents.

GISHOLT MACHINE CO., Madison, Wis., manufacturer of drills, lathes, boring mills, tool grinders, etc., has opened a sales office in the Hudson Terminal Building, Room 1253, New York. The office is in charge of Mr. Ellis F. Muther, who is in charge of Gisholt interests in the East. The eastern agency arrangement formerly in effect has been discontinued. Under the new arrangement Gisholt business will be given the closest attention by Gisholt experts.

CLEVELAND AUTOMATIC MACHINE CO., Cleveland, Ohio, is from four to six months behind on deliveries of automatic screw machines, having so many orders on hand that February 1, 1910, is the best delivery date that can be offered now. At the present time from 225 to 265 machines are actually under construction and about 400 to 500 are ordered which will follow as fast as possible. The condition of business is as good as the company has ever experienced since it has been manufacturing automatic machines.

NATIONAL MACHINE & TOOL WORKS, Rockford, Ill., succeeds the firm of Dalin Bros., manufacturers of hand milling machines. Edwin Cedarleaf and O. J. Sundstrand have purchased the business and will continue to manufacture hand milling machines, and will do die and tool work and build special machinery. Messrs. Cedarleaf and Sundstrand are experienced machinists and machine designers and have improvements ready to incorporate in the hand milling machine. The new company desires to make connections for representation both at home and abroad.

ALFRED THOMPSON, 71 Broadway, New York, who has had much experience in South American trade, prophesies that the next ten years will be a Latin-American decade, and that the material economic, intellectual and political advancement to be witnessed in South America will rival that which has been accomplished in the United States. The country is gifted with a great variety of climates and resources, navigable rivers, long extent of coast line, and other natural advantages of incalculable value. American manufacturers should awaken to the potential possibilities for trade in this vast domain.

NIAGARA MACHINE TOOL WORKS, corner Jefferson, Superior and Randall Sts., Buffalo, New York (formerly the Niagara Stamping & Tool Co.), has purchased a seven-acre plot adjoining the N. Y. C. Belt Line in Buffalo, and on it will erect a group of modern buildings in which to carry on the manufacture of machinery for working sheet metals, including presses, squaring and rotary shears, tinsmiths' tools, etc. The new plant will provide the company with superior facilities for carrying on its business, which has been developed during the past thirty years, and which will soon exceed the limits of the present quarters. In the new plant ample facilities will be provided for taking care of domestic and foreign trade.

NATIONAL AIR FILTER CO., 100-201 E. Madison St., Chicago, Ill., manufacturer of electric air-purifying apparatus, has installed in the air ducts of the Chicago Public Library an ozone generator system for the purpose of purifying the air and deodorizing the thousands of volumes, books, papers and periodicals contained in that large building. The apparatus has a capacity sufficient for "ozonizing" 15,000 cubic feet of air per minute. The apparatus is operated from a feed wire of 110 volts which is connected to a step-up transformer discharging the current at a voltage of 7,000 into a series of electrodes through which the air passes. The current consumption for 10,000 cubic feet of air per minute is only 660 watts.

WHEELER CONDENSER & ENGINEERING CO., Carteret, N. J., has improved the design of its surface condenser so that the coefficient of heat transferred has been increased from between 200 and 300 B.T.U. per square foot to between 800 and 900 B.T.U. per square foot per hour per degree F. average difference of temperature between the steam on one side of the surface and the water on the other. The importance of this increase is tremendous, especially to designing engineers of large power stations located on expensive land. It means that the condenser surfaces necessary are reduced from 2½ to 1 foot per rated horse-power, and removes one of the great obstacles to the steam turbine, *i. e.*, the excessive cost of condenser equipment required to give the high vacuum necessary for good economy.

CONTENTS FOR OCTOBER

J. M. Carpenter Tap & Die Co., Pawtucket, R. I., announces that for the past two years it has been finishing taps and dies to the A. S. M. E. standard as recommended by the American Society of Mechanical Engineers at the Indianapolis meeting, May, 1907. The company has a complete stock of taps and dies made to the U. S. Standard and other than regular pitches supplied at regular prices as per the new price list. There is no uniform standard of V-thread taps and dies that is interchangeable with different makes of taps and dies, and the company is distributing lists of thread forms other than regular United States standard at regular prices on hand taps, nut taps and tapper taps. Inasmuch as the V-thread will in the near future be made to order only and will thus soon become obsolete, it will be of general interest to users of taps and dies to have copies of these lists on file. They are sent on request.

Alfred J. Thompson, 71 Broadway, New York, who prior to 1893 was employed in the laboratory of Thomas A. Edison for four years, and who was associated in the sales departments of the Crocker-Wheeler Co. and the Allis-Chalmers Co., has formed a selling organization to market American machinery in the South American countries. Mr. Thompson has lived and traveled extensively in Cuba and every republic of South America during the last sixteen years, and has established cordial relations with the large dealers and users of machinery. Mr. Thompson believes that one cause of the lack of American trade with South America is improper representation, and he proposes to "hustle for business" on practical lines. His representatives will be experienced machinery salesmen who know how to canvass for business and write intelligent specifications. That the field is large for possible business is indicated by the fact that last year the South American countries purchased supplies and machinery to the extent of $756,000,000, only $240,000,000 coming to the United States.

Yale & Towne Mfg. Co., 9 Murray St., New York, which has its works at Stamford, Conn., has received a fine compliment from a well-known source. The factory organization is highly developed and the plant is well known to factory managers, organization engineers and others interested in highly developed and efficient manufacturing systems. The incident is as follows: A student of Sibley College, Cornell University, inquired how much credit he would be given for shop work done during vacation. He was told that it was the practice to give one hour credit to every two hours devoted to actual work in a shop or foundry provided they were approved by the faculty as a proper place for gaining useful experience. Upon asking if the Yale & Towne Mfg. Co.'s works at Stamford, Conn., met with the approval of the faculty, he was informed that double credit would be given for time spent in these works, as in the opinion of the faculty the experience that could be gained in the works was the full equivalent of the instruction given at the college, and that in this respect it ranks with a very few of the leading industries of the United States.

Dodge Mfg. Co., Mishawaka, Ind., reports that the organization of its employes, known as the Dodge Mutual Relief Association, has just celebrated its twenty-first anniversary. The association was organized July 1, 1889, for the purpose of assisting its members in case of disability arising from sickness or accident and to confer special benefit on the family or heirs in case of death. The association is the oldest one of its kind in Indiana, and it has paid out more than $15,000 in benefits. The membership is divided into two classes, the first including those whose weekly earnings exceed $6 per week. For this class the weekly dues are 5 cents and the benefits 80 cents per day, Sundays and holidays excepted. For the second class whose earnings are less than $6 per week, the weekly dues are 2½ cents per week and the daily benefits 40 cents per day. Membership fees are $1 for the first class and 50 cents for the second. All benefits continue for thirteen weeks as a limit for any one term during a year. In case of death of a member of the first class $50 is paid to the heirs, and in the second class, $25. Charles Endlich, secretary and treasurer of the company, has been the treasurer of the association since it was started.